Department of Energy
Washington, DC 20585
December 30, 2010

The Honorable Peter S. Winokur
Chairman
Defense Nuclear Facilities Safety Board
625 Indiana Avenue, NW, Suite 700
Washington, DC 20004-2901

Dear Mr. Chairman:

On December 1, 2009, the Department of Energy informed the Defense Nuclear Facilities Safety Board that a Technical Independent Project Review (TIPR) for the Engineered Container/Settler Tube Disposition Phase 1 of the K-Basin sludge project would be completed by December 31, 2010. This letter is to inform you that the TIPR, as required by Order 413.3A, was completed in June 2010, and was provided to your staff at that time.

Environmental Management Headquarters and the Richland Operations Office will continue dialogue with your staff as this project proceeds.

If you have any questions or require further information, please contact me or Kenneth G. Picha, Jr., Acting Deputy Assistant Secretary for Safety and Security Program at (202) 586-5151.

Sincerely,

Inés R. Triay
Assistant Secretary for
Environmental Management

Enclosure

Printed with soy ink on recycled paper

Engineered Container / Settler Tube (EC/ST) Disposition Phase 1 Technical Independent Project Review (TIPR) Report

Herb G. Sutter
Naeem Abdurrahman
Terry Foppe
Bob Hynes
Tim Hayes

June 5, 2010

Prepared for the
U.S. Department of Energy Richland Operations Office
Richland, WA

Signatures

Herbert G. Sutter, Team Lead — Date: 6/3/10

Naeem Abdurrahman, Team Member — Date: June 3, 2010

Terry Foppe, Team Member — Date: June 3, 2010

Bob Hynes, Team Member — Date: 6/3/10

Tim Hayes, Team Member — Date: June 5, 2010

Acknowledgments

The Sludge Treatment Process EC/ST Phase 1 Technical Independent Project Review (TIPR) Team thanks Mr. Tom Teynor, Mr. Roger Quintero, U.S. Department of Energy Richland Operations Office (DOE-RL), Mr. Gary Schuetz, GSSC DOE-RL Tech Support, and Mr. Mike Johnson, Mr. Rick Raymond, and the entire CH2M Hill Plateau Remediation Company (CHPRC) Sludge Treatment Process Project Management Staff for their exceptional support during this review. Mr. Quintero and Mr. Schuetz were the lead DOE-RL representatives responsible for organizing the on-site review. Mr. Johnson and Mr. Raymond and their staff, provided responsive support through technical presentations, discussions, and numerous reference documents.

The TIPR Team also acknowledges the excellent support provided by Dr. Sahid Smith, DOE-RL and Ms. Mary Cole, CHPRC who were instrumental in the preparation of this report.

Finally, the TIPR Team wishes to thank the DOE-RL STP Project, the U.S. Department of Energy (DOE) Chief of Nuclear Safety and support service contractor, Link Technologies, Inc., and the Los Alamos National Laboratory – Carlsbad Office who supports the DOE Carlsbad Field Office, for making team members available and providing their funding.

Executive Summary

Introduction: This report documents the results of the Engineered Container / Settler Tube (EC/ST) Disposition Phase 1 (also referred to as Engineered Container Retrieval and Transfer System, ECRTS, Project) Technical Independent Project Review (TIPR) conducted by a Team of independent experts in the Spring of 2010.

The Department of Energy Richland Operations Office (DOE-RL) is responsible for the Sludge Treatment Project (STP) at the Hanford Site in Washington State. The STP is a subproject of the K Basins Closure Project (KBCP) and is comprised of three stand alone sub-projects: Knockout Pot (KOP) Disposition; EC/ST Disposition Phase 1; and EC/ST Disposition Phase 2. The mission of the STP is to retrieve, treat, and package K Basins EC/ST sludge and Knockout Pot material for ultimate disposal at a national repository. The STP is a non-major system project that is subject to the requirements of DOE Order 413.3A. The EC/ST Phase 1 subproject is currently preparing for Critical Decision (CD)-1. The contractor has submitted a CD-1 package for the EC/ST Disposition Phase 1 subproject to DOE-RL.

DOE Order 413.3A, Table 2, CD Requirements, establishes prerequisites and requirements for CD approvals. Readiness preparations for CD-1 approval include the performance of a Design Review (DR) of the conceptual design and a project review. A TIPR is a required as component of the DR which is designed to independently verify that the safety basis documentation is sufficiently conservative and bounding and that safeguards and security has been appropriately considered during CD-1.

Results: The TIPR Team reports no Findings, nine Observations, and seven Recommendations which are summarized in Section 10 of this document.

The conclusions of the TIPR Team are summarized as follows:

> **SAFETY BASIS DOCUMENTATION** – *The safety basis documentation supporting STP Phase 1 conceptual design is sufficiently conservative and bounding to be relied upon for the next phase of the project.*

The depth and quality of safety basis documentation and its integration in conceptual design is commendable. It faithfully and appropriately applies the DOE-STD-1189 approach and provides the expected level of detail necessary to support CD-1 decisions. The STP Hazards Analysis and Accident Analysis were developed per the guidance from DOE-STD-1189, including evaluating alternatives, and provide the expected level of detail necessary to support CD-1 decisions. The level of detail of the STP hazards and accident analysis to support the Conceptual Safety Design report (CSDR) is perhaps more than what may be available for other projects since the process hazards and control strategy associated with STP transfers have previously been evaluated, therefore, appropriate lessons learned have been applied. The quantitative STP Accident Analysis of facility-level Design Basis Accidents provides a sound technical basis for the selection of Safety Significant SSCs at CD-1, which is supplemented by the additional Safety

Significant criteria from the Hazards Analysis results. Overall, the hazards analysis, accident analysis, and control decision report establish the safety functions and functional requirements for determination of Safety Significant SSCs and potential TSR Specific Administrative Controls, and provide a solid foundation for the safety analysis and preliminary design to proceed. Issues that require resolutions to further support the safety basis for conceptual design are identified by numbered recommendations in this report; the numbered observations should also be considered by the Project. The identified risks and opportunities associated with the safety basis highlight where major impacts are possible and need to be managed.

> **TRANSPORTATION SAFETY–** *The transportation safety documentation supporting STP Phase 1 conceptual design is sufficiently conservative and bounding and applicable controls are appropriate to support transporting STP sludge to T-Plant.*

The overall approach to develop and approve transportation safety documents for the transfer of sludge to T-Plant is appropriate for the STP conceptual design. The existing procedural controls are sufficient to ensure compliance with the TSD. The conceptual design for transportation safety is based on conservative assumptions and analyses that are consistent with the Criticality Safety Evaluation Report (CSER) for the planned waste packaging. Analyses demonstrate planned shielding will achieve compliant dose rate limits established in the transportation safety basis and that expected hydrogen gas and heat generation values will not exceed the gas generation and thermal limits established in the transportation safety basis.

> **SAFEGUARDS & SECURITY –** *The conceptual design is consistent with safeguards and security approvals.*

The safety design basis was developed in a reasonably conservative manner, and the risk associated with significant redesign due to the addition of new or different safeguards requirements is minimal. The STP has documented bounding security requirements by completing a Limited Security Assessment. The nuclear facility safety, radiological, and shipping controls have more stringent restrictions and bound any physical security and Nuclear Material Control and Accountability (NMC&A) impacts on the design.

Table of Contents

List of Figures

List of Tables

Acronyms and Abbreviations

CD	Critical Decision
CFR	Code of Federal Regulations
CHPRC	CH2M HILL Plateau Remediation Company
CIPT	Contractor Integrated Project Team
CSB	Canister Storage Building
CSDR	Critical Safety Design Report
CSE	Criticality Safety Evaluation
CSER	Criticality Safety Evaluation Report
CVDF	Cold Vacuum Drying Facility
CVS	Confinement Ventilation System
CY	Calendar Year
DBAs	Design Basis Accidents
DNFSB	Defense Nuclear Facilities Safety Board
DOE	U.S. Department of Energy
DOE-RL	Department of Energy Richland Operations Office
DR	Design Review
DOT	U.S. Department of Transportation
ECs	Engineered Containers
ECRTS	Engineered Container Retrieval and Transfer System
EC/ST	Engineered Container/Settler Tube
EM	Office of Environmental Management
ETR	External Technical Review
FIPT	Federal Integrated Project Team
F-SPA	Fuel-SPA
FY	Fiscal Year
HI	Hazard Identification & Control Selection
HIH	Hose-in-Hose
IXM	Ion Exchange Module
KBCP	K Basins Closure Project
KE	K East
KOP	Knockout Pot
KW	K West
LA	Limited Area
LDC	Large Diameter Container
LOI	Line of Inquiry

LSA	Limited Security Area
MAR	Material-at-Risk
NMC&A	Nuclear Material Control and Accountability
NPH	Natural Phenomena Hazards
NRC	Nuclear Regulatory Commission
ORT	Overfill Recovery Tool
OTRS	One-Time Request for Shipment
PDSA	Preliminary Documented Safety Analysis
PHA	Preliminary Hazard Analysis
PR	Risk to Project Safety Decisions
PSDR	Preliminary Safety Design Report
PSSD	Package-specific safety document
PSVR	Preliminary Safety Validation Report
RCR	Review Comment Record
SARAH	Hanford Safety Analysis and Risk Assessment Handbook
SA	Security Assessment
SBRT	Safety Basis Review Team
SD	Safety Design Strategy & General Requirements
SDIT	Safety Design Integration Team
SDS	Safety Design Strategy
SMD	Sauter Mean Diameter
SNM	Special Nuclear Material
SPA	Special Packaging Authorization
SPA-SEC	SPA Shipment Evaluation Checklist
SSCs	Structures, Systems, and Components
STP	Sludge Treatment Project
STs	Settler Tanks
STS	Sludge Transport System
STSC	Sludge Transport Storage Container
T&P	Transportation and Packaging
TIPR	Technical Independent Project Review
TRA	Technology Readiness Assessment
TRL	Technology Readiness Level
TSD	Transportation Safety Document
TSR	Technical Safety Requirements
VA	Vulnerability Assessment
WIPP	Waste Isolation Pilot Plant
WTP	Waste Treatment Plant

1 Introduction

1.1 K Basins Background

The Department of Energy Richland Operations Office (DOE-RL) is responsible for the Sludge Treatment Project (STP) at the Hanford Site in Washington State. The STP is a subproject of the K Basins Closure Project (KBCP) and is comprised of three stand alone sub-projects: Knockout Pot (KOP) Disposition; Engineered Container / Settler Tube (EC/ST) Disposition Phase 1; and EC/ST Disposition Phase 2. The mission of the STP is to retrieve, treat, and package K Basins EC/ST sludge and Knockout Pot material for ultimate disposal at a national repository. The STP is a non-major system project that is subject to the requirements of DOE Order 413.3A. The contractor has submitted a CD-1 package for the EC/ST Disposition Phase 1subproject to DOE-RL.

The K West (KW) engineered containers (ECs) and settler tubes (STs) contain sludge that was cleaned up from K East (KE) Basin and KW Basin floors and sludge generated from the washing and packaging of spent nuclear fuel. The sludge contained in the STs is currently being retrieved into an EC.

The STP faces significant challenges to successfully retrieve, treat, package and dispose of K Basin sludge material. DOE has attempted several different technical approaches to disposition this material using different technologies and contracting approaches. None have proven mature enough to successfully deal with this unique material. Previous technical approaches failed to demonstrate technical feasibility and adequate technical maturity and were abandoned prior to detailed design.

In 2007 DOE-RL and the performing contractor (Fluor Hanford) performed a Technology Readiness Assessment (TRA)(1) to determine whether the project had adequately developed needed technologies. The TRA team concluded that the critical technologies associated with the project plans were not at the maturity level needed to support a CD-3 to procure and construct the sludge treatment process. This conclusion supported the contractor's recommendation and the DOE-RL decision to re-baseline the STP to between CD-0 and CD-1.

Subsequently, DOE-RL directed Fluor Hanford to develop a CD-1 package that would include alternative analyses for removal of the sludge stored in the K West Basins, in accordance with DOE Order 413.3A and DOE Standard 1189. DOE-RL also identified removal of the sludge from the K West Basin and its relocation away from the River Corridor as soon as possible as a key DOE objective(1). A change in performing contractors from Fluor Hanford to CH2M Hill Plateau Remediation Company (CHPRC) occurred in October 2008. CHPRC submitted an alternative analysis and submitted the *Sludge Treatment Project Alternative Analysis Summary Report* on January 26, 2009(2).

In order to achieve the Hanford 2015 Vision for the River Corridor, CHPRC recommended a two phased approach. Phase 1 would remove the sludge from K Basins and relocate it to safe interim storage on the Hanford Central Plateau; Phase 2 would remobilize, treat, and package the sludge for transport and disposal at the Waste Isolation Pilot Plant (WIPP).

1.2 Phase 1 Process, Scope , and Schedule

Phase 1 activities begin with the retrieval of the sludge from the ECs. The retrieval process transfers the sludge from an EC into a Sludge Transport Storage Container (STSC). Excess transfer water will be decanted from the STSC and returned to the basin, resulting in filling each STSC with an optimal volume of sludge. Loaded STSCs will be transported to T-Plant where they will be stored until Phase 2.

Figure 1.1 depicts key Phase 1 process steps and systems identified from *Preliminary STP Container and Settler Sludge Process System Description and Material Balance*(3). Key steps and systems are discussed below.

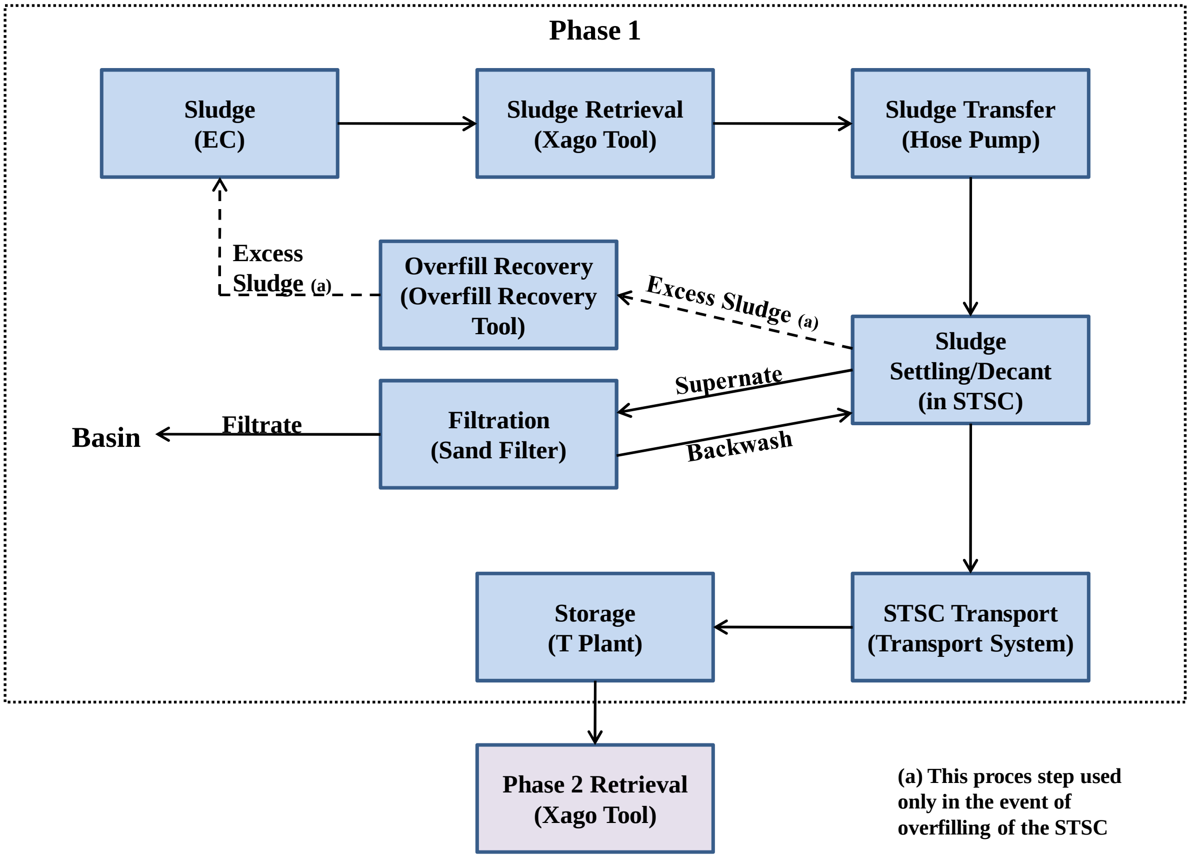

Figure 1-1 Key Process Steps and Systems for Phase 1 Sludge Treatment and Phase 2 Retrieval

1.2.1 Inventory

Tables 1-1 and 1-2 describe the composition and sludge volumes from the various sources. Detailed chemical and physical properties of the sludges can be found in HNF-41051[(3)], HNF-SD-SNF-TI-009, Vol.2[(4)], PNNL-14947[(5)], and PNNL-19035[(6)].

Table 1-1 Sludge Composition(3)

Sludge Source	Composition
K East K West	K East/West sludge ranges in particle size from a few microns to less than 6,350-µm (1/4 inch). It is primarily iron and aluminum oxides, concrete grit, sand, dirt, paint chips, and operational and biological debris. It is contaminated with fuel corrosion products and small fragments of metallic uranium (the mean concentration of metallic uranium in KE sludge is ~ 0.006 and the mean concentration of metallic uranium in KW sludge ~ 0.03 g/cm^3). More detailed characterization results from a recent EC sampling campaign will be available by late Fiscal Year (FY) 2010.
Settler Tubes	Settler tube sludge ranges in particle size from a few microns to <600 microns. It is expected to be primarily uranium corrosion products and fission and activation products, with some remaining metallic uranium (the mean concentration of metallic uranium in the sludge ~0.05 g/cm^3). Settler sludge may also contain lesser quantities of iron oxides, aluminum oxides, sand, Grafoil (graphite gasket material) fragments, concrete grit, dirt, and other operational debris. Settler Tanks sludge will be sampled and characterized after it has been transferred to the ECs. Sampling will be completed in FY 2010, and characterization completed in early FY 2011.

Table 1-2 Estimated Sludge Volumes(3)

	KE Originating			KW Originating		Settler Tubes
	EC 240	EC 250	EC 260	EC 210	EC 220	EC 230
Volume (a)	2.6 m^3	7.7 m^3	8.1 m^3	4.1 m^3 (b)	1.0 m^3	5.4 m^3 (c)

Notes:
(a) Each container volume is considered accurate to +/- 0.4 m^3
(b) Includes an estimated 1.3m^3 of sludge still present on the KW floor that will be retrieved into EC 210 late FY 2010.
(c) Settler tube volume is estimated. Retrieval to EC 230 is currently in progress. The bounding estimated volume is 7.6 m^3.

1.2.2 Sludge Retrieval

The Retrieval process extracts the sludge from the ECs and feeds it into the transfer line. The sludge retrieval system consists of the Xago Ltd. HydroLance™ (Xago) tool component, pumps to supply treated pressurized water from the basin ion-exchange system, ancillary instrumentation, and piping and hoses required to deliver the sludge-bearing stream to booster pump that will transfer it to the STSC. The Xago tool was developed specifically for sludge retrieval. It uses modified existing educator technology packaged in a specialized tool that can be deployed and operated underwater in the KW Basin.

1.2.3 Sludge Transfer

Retrieved sludge will be transferred to the STSCs using a hose in hose transfer line, remote connectors, and a submerged slurry pump. The hose-in-hose (HIH) transfer line and remote connectors are standard designs that have been used at Hanford for a number of applications. The current baseline slurry booster pump is an industrial hose pump (peristaltic pump) designed for abrasive slurry applications. The pump will be modified to allow it to operate submerged.

1.2.4 Sludge Settling and Decant

The Sludge Settling and Decant process consists of the incremental filling of the STSC receiving vessel and intermittent decanting of excess mobilizing water. This operation loads the STSC with an optimal sludge volume and recovers the mobilizing water, recycling it back to the basin. The existing process flow allows sixteen hours for the sludge to settle. After settling the supernate will be drawn off and additional sludge will be loaded into the STSC. The settling/decant process will be repeated until the STSC is loaded with the desired amount of sludge. The sludge working volume of the STSC will depend on the characteristics of the sludge being processed. The maximum STSC working volumes for settler and basin sludges are ~2.7 m^3 and 3.3 m^3 respectively(3) . The amount of sludge that will be loaded into each STSC will be determined by variety of factors including, fissile content, dose, gas generation and retention, heat generation, and sludge expansion caused by uranium oxidation. In the STSC, the sludge volume will be less than two thirds of the working capacity. The rest of the volume will be supernate. Loading will be monitored using level indication and mass (modified truck scales).

1.2.5 Filtration

After decanting the supernate is filtered through a sand filter. Filtered supernate is returned to the Basin. The filtrate is to contain less than 90 mg/L (ppm) solids, which is the present requirement to maintain K Basin water clarity. The solids accumulated on the filter are backwashed to the STSC at the end of the filling cycle.

1.2.6 Overfill Recovery

In the event that a STSC is overfilled, the excess sludge will be removed and returned to the ECs using the Overfill Recovery Tool (ORT). The ORT is a direct suction retrieval lance with a mobilizing nozzle similar to the existing Settler Retrieval Tool currently installed in the 105KW Basin. Mobilization and dilution water will be provided by pumps which supply treated pressurized water from the existing basin ion exchange module (IXM) system. An Overfill Recovery pump will be utilized to provide the direct suction and motive force necessary to pump the sludge back to the engineered container.

1.2.7 STSC Transport

The STSC Transport System includes the STSC & Transporter Loading Facility and the Sludge Transport System (STS). The STSC & Transporter Loading Facility will be a remotely operated facility in the KW Basin annex that will facilitate direct loading of STSCs. The STSC Transport System is an existing, trailer based system. An empty STSC will arrive at the annex in a Sludge Transport System (STS) Cask on the STS Transporter. Transfer hoses and instrumentation will be manually connected to the STSC. Personnel will then exit the annex for remote loading of sludge into the STSC. The STSC and STS Cask remain on the Transporter during sludge loading. After loading, personnel enter the annex and manually disconnect transfer hoses and instrumentation from the STSC and decontaminate the transporter. The space above the supernate in the STSC as well as the void space in the STS cask will be inerted with argon. Cask and STSC will be transferred to T-Plant.

As shown in Table 1-3, the STP expects to load ~25 STCs with sludge.

Table 1-3 Number of STSCs Produced

Sludge Source	Estimated Number of STSCs
K East Sludge	9
K West Sludge	4
Settler Tube Sludge	11
Sand Filter Sludge	1
Total	**25**

1.2.8 Sludge Storage at T-Plant

Sludge Storage in STSCs at T-Plant relies on existing systems with previously used equipment. Although, loaded STSCs may impose new controls and requirements, the basic technologies required have been used for other similar waste packages.

1.2.9 Phase 2 Sludge Retrieval

Phase 2 plans to treat and dispose of the sludge have not yet been developed. The project intends to use the Xago tool to remobilize and retrieve the sludge from the STSCs prior to final treatment. The waste will reside in the STSCs until treatment begins.

1.2.10 Schedule

CHPRC has prepared a CD-1 package for STP Phase 1, with submittal to DOE-RL for approval in the summer of 2010. Submission of a CD-2/3 package is scheduled for the end of 2011. Operations are scheduled to begin in the spring of 2013 and be completed by the end of calendar year (CY) 2014.

1.3 Previous Reviews

As noted in Section 1.1, DOE-RL and the performing contractor (Fluor Hanford) performed a TRA(1) to determine whether the project had adequately developed needed technologies in 2007. The TRA team concluded that the critical technologies associated with the project plans were not at the maturity level needed to support a CD-3 to procure and construct the sludge treatment process. This conclusion supported the contractor's recommendation and the DOE-RL decision to re-baseline the STP to between CD-0 and CD-1.

In March 2009(7) an External Technical Review (ETR) evaluated the areas of project management, technical risks, regulatory risks, system risks, and safety risks. The ETR found that the two phased approach for the STP EC/ST was appropriate. Several recommendations resulting from the ETR have been incorporated into the project planning and technology development. Phase 1 testing and technology demonstrations of the technical elements of the conceptual design determined that the critical technical elements needed to perform their functions were feasible. A Technology Readiness Assessment (TRA) completed in October 2009(8) confirmed that all critical technologies were at Technology Readiness Level (TRL) 4 or higher. (TRL 4 or higher is the recommended level of technology development for CD-1.)

2 Technical Independent Project Review (TIPR)

2.1 Background and General Guidance

From the Charter[9]:

> The Sludge Treatment Project (STP) is a non-major system project that is subject to the requirements of DOE Order 413.3A[10]. The STP is comprised of three stand alone sub-projects, the Knockout Pot (KOP) Disposition, the Engineered Container / Settler Tube (EC/ST) Disposition Phase 1 and EC/ST Disposition Phase 2. The Critical Decision (CD) requirements of the order are being applied to the EC/ST Phase 1 subproject. The EC/ST Phase 1 subproject is preparing for CD-1. The safety basis strategy for the KOP Disposition subproject is to authorize activities and minor modifications under the current safety basis documentation at Hanford for multiple facilities, evaluating the proposed changes through the Unreviewed Safety Question Determination process and/or development of safety basis amendments for DOE-RL approval, and is not within the scope of this TIPR. However, the Title 10 Code of Federal Regulations (CFR) 830[11] major modification determinations will be reviewed by the TIPR. The EC/ST Phase 2 subproject is also not within the scope of this TIPR.
>
> DOE Order 413.3A, Table 2, CD Requirements, establishes prerequisites and requirements for CD approvals. Readiness preparations for CD-1 approval include the performance of a Design Review (DR) of the conceptual design and a project review for CD-1. As a specific component of the DR, a Technical Independent Project Review (TIPR) is required to independently verify that the safety basis documentation is sufficiently conservative and bounding and that safeguards and security has been appropriately considered during CD-1. The TIPR is not intended to duplicate the DOE-RL technical review of the adequacy of the CD-1 design submittal, such as compliance with safety-related design codes and standards, e.g., radiation protection per 10 CFR 835, Subpart K Design and Control[12], fire protection, safety and health, environmental, etc.. That review will determine whether the products (drawings, analysis, or specifications) are correct and will perform their intended functions and meet requirements. The DOE-RL review will also ensure that the conceptual design package has adequately implemented the safety-in-design process to integrate safety in the design development process.
>
> The project review is a broad evaluation of the project maturity of the supporting programs and documents at the conceptual stage of development. Some components of the project review that fall under the definition of TIPR already have been performed at appropriate times in order to be effective for the development of the concept. An External Technical Review (ETR)[7] performed in March 2009 evaluated the areas of project management, technical risks, regulatory risks, system risks, and safety risks. The

> ETR found that the two phased approach for the STP EC/ST was appropriate. Several recommendations resulting from the ETR have been incorporated into the project planning and technology development. Phase 1 testing and technology demonstrations of the technical elements of the conceptual design determined that the critical technical elements needed to perform their functions were feasible. A Technology Readiness Assessment (TRA)(8) completed in October 2009 confirmed the technology readiness level to support CD-1.

2.2 STP TIPR Scope, Schedule, Team

Material on the TIPR scope and Team, including biographies of Team members are contained in Appendices B (TIPR Charter) and C (Biographies).

2.2.1 Scope

The scope of this TIPR is limited to the Engineered Container / Settler Tube (EC/ST) Disposition Phase 1 sub-project. The TIPR examined three main areas; safety basis, transportation, and safeguards and security.

Per the Charter:

> This [TIPR] review will provide an independent verification of the CD-1 safety basis documents to confirm that analyses and decisions are sufficiently conservative and bounding. It focuses on safety design package key elements including the safety design strategy, safety guidance and requirements, hazards identification and control selection, Conceptual Safety Design Report, risks to project safety decisions, and safety design integration team interactions.
>
> This review will provide an independent verification that the strategy for developing the transportation safety basis documents is consistent with requirements. DOE STD 1189(13) does not include the transportation safety basis. The Hanford Site-wide Transportation Safety Document (TSD)(14) for onsite Transportation and Packaging at Hanford, approved by DOE-RL, authorizes methods described in the TSD to comply with 10 CFR 830.207a(11) and DOE O 460.1A, Attachment 1, Criteria 5(15). The appropriateness of the conceptual plan for packaging and transport should be confirmed.
>
> This review will provide an independent verification that the conceptual design has integrated the conditions and controls that are required for material control and accountability Nuclear material accountability and controls are required for sludge in the K West Basis and the methods that involve deviations from requirements for managing all of the process steps must be planned and integrated into the STP operations. The current safeguards deviation approval, documented in 10-SES-0054, 8 January 2010(16), identifies conditions and controls that affect the STP activities.

2.2.2 Schedule

The schedule is given in Table 2-1, below

Table 2-1 TIPR Schedule

Date **Time**	**Time**	**Activity**
Pre On-Site		
Monday, April 12	COB	Finalize Initial Reading List
Friday, April 16	COB	Initial Reading Material Distributed
Friday, April 23	COB	Additional Reading Material Distributed (if needed) Finalize Charter (including LOIs)
On-Site: Monday, May 3 - Friday, May 7		
Monday, May 3	8:00-4:00 4:00-4:30 4:30-5:00	Presentations (Process, Safety, Transportation, Safeguards/Security Visit to MASF (prototypic test facility) View Transportation facilities Team Meeting (Team only) Daily Close Out (Team, DOE, Contractor)
Tuesday, May 4	8:00-4:00 4:00-4:30 4:30-5:00	Project Presentations, Visits, Interviews, etc. Team Meeting (Team only) Daily Close Out (Team, DOE, Contractor)
Wednesday, May 5	8:00-4:00 4:00-4:30 4:30-5:00	Interviews, etc. Team Meeting (Team only) Daily Close Out (Team, DOE, Contractor)
Thursday, May 6	3:30-4:30	Exit Brief
Post On-Site		
Friday, May 21	COB	FAC Draft Submitted
Wednesday, May 26	COB	FAC Completed
Friday, June 4	COB	Final Report Submitted

2.2.3 Team

The TIPR Team was composed of independent experts from the DOE and the private sector.

Table 2-2 TIPR Team

Name	**Responsibility**	**Employer**
Dr. Herb Sutter	Team Leader	Consultant EM/HQ
Dr. Naeem Abdurrahman	Nuclear Safety Basis	EM-21
Terry Foppe	Nuclear Safety Basis	Consultant Office of the Chief of Nuclear Safety
Bob Hynes	Transportation Safety	WMG Inc.
Tim Hayes	Safeguards & Security, Safety Basis	LANL-CO (WIPP)

2.3 Lines of Inquiry (LOIs)

LOIs were developed using the guidance provided in DOE G 413.3-9, *U.S. Department of Energy Project Review Guide for Capital Asset Projects*(17). Safety basis LOIs were taken from the Standard Review Plan, *Conceptual Safety Design Review Module*(18) and augmented by additional LOIs developed by the Team. LOIs for transportation safety and safeguards and security were developed by the Team in cooperation with the Project. The LOIs can be found in Appendix A and also in Appendix B, of the TIPR Charter.

The LOIs in the form found in Appendix A, but with the right hand two columns labeled "Met?" and "Comments, Basis, Documentation" blank, were submitted to DOE-RL in late April and forwarded to the contractor. The contractor performed a self evaluation by filling in the two columns. The contractors self evaluation was made available to the Team just before the on-site meeting. The Appendix A LOI tables were filled out by Team members based on their understanding of the available documentation. The on-site presentations and interviews and the contractor's self evaluation were used to guide discussion and document review, but a fundamental rule of the evaluation was, "If it's not written down, it doesn't exist."

2.4 Report Organization

The following chapters of this report are organized along the lines of the LOIs, one chapter per major LOI heading. Each chapter begins with a brief introduction, followed by a summary discussion of the LOI results from Appendix A and, finally, observations, recommendations, and conclusions.

3 Safety Design Strategy & General Requirements

3.1 Introduction

The following Lines of Inquiry (LOIs) were developed to address the adequacy of the safety design strategy (SDS) and associated general requirements from the guidance provided in the DOE-STD-1189-2008, *Integration of Safety in the Design Process*[13]:

SD-1 Does the SDS include the key elements required by DOE-STD-1189?

SD-2 Does the SDS meet the format and guidance criteria in DOE-STD-1189, Appendix E?

SD-3 Did the hazard analysis activities in the conceptual design phase address the key elements of DOE-STD-1189 Section 3.2?

Additional details of these LOIs and their responses are documented in Appendix A, Table A-1, "Safety Design Strategy & General Requirements (SD)". This section provides the overall assessment regarding adequacy of the SDS.

3.2 LOI Results

3.2.1 SD-1

The SDS is documented in HNF-34374, *Sludge Treatment Project Safety Design Strategy*[19]. The initial SDS was developed in 2007 and committed to adopting the draft DOE-STD-1189. The SDS Revision 1 was issued in July 2008 to reflect the revised project mission and commitment to implement the DOE-STD-1189-2008 issued in April 2008. Revision 2 updated the SDS to reflect the selection of alternatives, Knockout Pot (KOP) disposition decisions, and the project CD-2/3 tailoring approach. Revision 3 updates the SDS to reflect the conclusions of the Conceptual Safety Design Report (CSDR) and the maturity of design as presented in the CD-1 report, and describes the future safety basis plans for a Preliminary Documented Safety Analysis (PDSA). The SDS was submitted along with the CD-1 package for DOE-RL approval. A Preliminary Safety Design Report (PSDR) and approval by DOE in a Preliminary Safety Validation Report (PSVR) as recommended in the DOE Standard are not planned due to the tailored CD-2/3 project approach.

The SDS includes all the key elements required by DOE-STD-1189. Consistent with the requirements of DOE-STD-1189, the SDS:

- Describes the overall safety strategy
- Describes the strategy for certain high-cost, safety-related design decisions
- Identifies key assumptions or inputs that may represent potential risks to those decisions
- Identifies the expected safety deliverables through the project.

There are multiple 10 CFR 830[11] safe harbor methodologies that are applicable to the STP Phase 1 for the retrieval of sludge from the K-Basins. The STP Phase 1 interfaces with the K-Basins and T-Plant current safety bases and the Transportation Safety Document are addressed in the SDS Section 5.1.1, "Activities and Deliverables".

KOP retrieval from the KW Basin using Multi-Canister Overpacks is being evaluated per the Unreviewed Safety Question Determination process against the 105-KW Basin Final Safety Analysis Report (FSAR), HNF-SD-WM-SAR-062[20]. The major modification determination for drying the material at the Cold Vacuum Drying Facility (CVDF) and storing at the Canister Storage Building (CSB) are documented in PRC-STP-00147, *Knock-Out Pot Major Modification for the 105-K West Basin, Cold Vacuum Drying Facility, and Canister Storage Building*[21], which used the evaluation criteria provided in Table 8-1 of DOE-STD-1189[13]. DOE-RL letter 10-SED-0099[22] concurred that these activities are not major modifications against the current approved safety basis documents, but will require revisions due to the need for new or revised Technical Safety Requirements (TSRs) and safety Structures, Systems, and Components (SSCs). The determination was reviewed and concluded to be adequate to support the decision.

Another major modification determination is documented in PRC-STP-00109, *Sludge Treatment Project Major Modification Determination for T-Plant*[23], using the evaluation criteria provided in Table 8-1 of DOE-STD-1189[13]. DOE-RL letter 10-SED-0037[24] concurred that STSC storage is not a major modification for T-Plant but will require revisions due to the need for new or revised TSRs and safety SSCs. The determination was reviewed and concluded to be adequate to support the decision.

The EC/ST Disposition Phase 1 activities involving sludge retrieval from Engineered Containers and Settler Tubes at the KW Basin were recognized to be a major modification and are following the DOE-STD-1189 approach for safety integration in design. The safe harbor to authorize EC/ST operations by upgrading the Preliminary Documented Safety Analysis (PDSA) will be a Documented Safety Analysis prepared per DOE-STD-3009-94, *Preparation Guide for U.S. Department of Energy Nonreactor Nuclear Facility Documented Safety Analyses*[25].

3.2.2 SD-2

The SDS meets the format and guidance provided in DOE-STD-1189, Appendix E, "Safety Design Strategy". It includes major sections that provide a description of the project, document the safety strategy and philosophy, summarize risks to project safety decisions, identify the safety analysis approach and plan, and describe the Safety-in-Design Integration Team interfaces and integration with the design project. DOE-RL had previously approved the SDS, and is in the process of approving Revision 3, having not identified any major issues.

3.2.3 SD-3

The hazard analysis activities in the conceptual design phase addressed the key elements of DOE-STD-1189 Section 3.2, "Conceptual Design Phase" (Safety Considerations for the Design Process). Major hazards have been identified, and references to previous safety analyses were provided. Preliminary hazards analyses were performed to evaluate design alternatives, and a more detailed process hazards analysis, which was prepared for the preferred alternative. A preliminary fire hazards analysis and a preliminary criticality safety evaluation were prepared. Facility-level Design Basis Accidents were evaluated, and safety functions were identified to prevent or mitigate them. The hazard analysis was used to establish a preliminary designation of Safety Significant SSCs, which is documented in the CSDR. The hazard analysis results were also used to develop the Safety-in-Design Risk and Opportunities Assessment. The EC/ST activities are determined to be Hazard Category 2. All of these topics are addressed further in Sections 4, 5, 6, and 7, and additional discussions are provided in Appendix A, Table A-1.

3.3 Observations, Recommendations, and Conclusion

Observations

- **Observation 3-1**: Not developing a Preliminary Safety Design Report (PSDR) / Preliminary Safety Validation Report (PSVR) and waiting until DOE approves a Preliminary Documented Safety Analysis (PDSA) is not consistent with the DOE-STD-1189 safety-in-design approach. This CD-2/3 approach warrants continuous oversight from the DOE-RL Federal Integrated Project Team. In addition, as a best practice, it is suggested that the STP project schedules include appropriate DOE-RL Safety Basis Review Team in-process reviews, or formal reviews at key milestones, to assure earlier identification of any significant issues as the design and safety analysis proceeds.

  Discussion: The EC/ST Disposition Project is in compliance with the tailoring of the CD-2/3 as allowed by DOE Order 413.3A(10), Table 2, “Critical Decision Requirements”. However, since no PSDR and corresponding DOE approval in a PSVR are planned due to the tailored CD-2/3 project approach, the potential exists for missed opportunities to assure that the safety analysis progresses sufficiently as the design matures, and that appropriate levels of DOE concur with the evolving safety basis decisions. One topic of particular importance is the project decisions on classifying defense-in-depth SSCs and the confirmations of the current safety classifications for the Confinement Ventilation System and the Fire Suppression and Alarm Systems. Another important area where adequate safety basis development is paramount is for the situation where the need arises to request DOE approval per 10 CFR 830.206(11) of procurement of long lead items or limited start of construction before a PDSA is approved by DOE. This has been an issue with other projects in the DOE Complex, and is a current lesson learned from the same tailored CD-2/3 approach being applied to the Y-12 Uranium Processing Facility (per a draft TIPR report being written). Consistent with the SDS, the hazards analyses, and control documentation will be updated in support of preliminary design. These updates will be available for DOE-RL review.

Recommendations

- **Recommendation 3-1**: Revise PRC-STP-00139, *Sludge Treatment Project Engineered Container Retrieval and Transfer System, Safety Equipment List*, to delete the identification of the KW Basin Annex lightning protection system as Safety Significant, and add instead the fire resistance of the building structure and ventilation ductwork, and building grounding.

  Discussion: As documented in the CSDR and the Control Decision Report, the fire resistance of the building structure and ventilation ductwork to prevent collapse that could cause a spray release or explosion, and the building grounding system to prevent explosions, were selected as Safety Significant SSCs. However, these are not identified on Tables 3 and 4 of PRC-STP-00139(26). The STP Project explained that classifying the lightning protection system as Safety Significant was considered during the control decision process, but not selected due to the other credited controls that were selected as Safety Significant SSCs.

Conclusion

The SDS for the STP Phase 1 adequately meets the expectations of DOE-STD-1189. Revision 3 updates the SDS to be current with the safety basis development for the CD-1 package submittal. Appropriate preliminary hazards analyses have been performed to support the development of the CSDR. The STP Project plans to update the SDS for each succeeding phase through project completion. Issues that require resolution to further support the safety basis for conceptual design are identified in the above recommendations; the observations listed above should also be considered by the Project.

4 Hazard Identification & Control Selection

4.1 Introduction

The following Lines of Inquiry (LOIs) were developed to address the adequacy of the hazard analysis to support the conceptual design, and application of guidance from DOE-STD-1189-2008, *Integration of Safety in the Design Process*[13]:

HI-1 Did the hazard analysis activities in the conceptual design phase address the key elements of DOE-STD-1189 Section 4.2? When design requirements are established, are alternatives evaluated to establish a process approach that includes facility and equipment arrangements?

HI-2 Are controls strategies for Design Basis Accidents (DBAs) clearly identified in the hazard analysis? Does the DBA control strategy include required safety functions and classifications?

HI-3 Were the necessary inputs for the completion of the PHA provided and used in the PHA process?

HI-4 Did the hazards analysis performed in the conceptual design phase identify the high cost safety functions and design requirements for the SSCs that will be included in the project?

HI-5 Did the PHA establish an appropriate suite of DBAs to define functional and performance requirements for the facility design?

HI-6 Are the hazardous release event evaluations based on facility-level events?

HI-7 For those events with consequences that do not lead to selection of safety class or safety significant controls, does the analysis identify the controls that are appropriate for facility worker, collocated worker, and public defense-in-depth?

Additional details of these LOIs and their responses are documented in Appendix A, Table A-2, "Hazard Identification & Control Selection (HI)". This section provides the overall assessment regarding adequacy of the hazard analysis to support the conceptual design.

4.2 LOI Results

4.2.1 HI-1

The hazard analysis activities in the conceptual design phase addressed the key elements of DOE-STD-1189 Section 4.2, "Conceptual Design Phase" (Hazard and Accident Analyses). The hazards analysis, accident analysis, and control decisions were performed for the draft conceptual designs of the two alternatives, i.e., Direct Hydraulic Loading and Underwater Loading into Small Containers. These analyses are documented in PRC-STP-00012, *What-IF/Checklist Hazard Analysis for the Sludge Treatment Project Direct Load Alternative Conceptual Design*[27], and PRC-STP-00037, *What-IF/Checklist Hazard Analysis for the Sludge*

Treatment Project Small Container Sludge Retrieval Draft Conceptual Design(28). They were performed using the Safety Design Guiding Principles and key concepts provided in DOE-STD-1189.

For the preferred Direct Hydraulic Load alternative, PRC-STP-00124, *Sludge Treatment Project Engineered Container Retrieval and Transfer System Hazard Analysis*(29), PRC-STP-00154, *Sludge Treatment Project Engineered Container Retrieval and Transfer System Accident Analysis*(30), and PRC-STP-00161, *Sludge Treatment Project Engineered Container Retrieval and Transfer System Conceptual Design Control Decision Report*(31), were prepared and used to develop the PRC-STP-00156, *Sludge Treatment Project Conceptual Safety Design Report*(32).

PRC-STP-00158, *Sludge Treatment Project Engineered Container Retrieval and Transfer System Conceptual Design Hazards Categorization*(33) and CSDR Section 3.2 "Comparison of Inventories to Threshold Quantities" provide the hazard categorization of the facility as Hazard Category 2.

Facility-level design basis accidents are identified and analyzed in the Accident Analysis PRC-STP-00154 and in the CSDR Chapter 4.0, “Design Basis Accidents”, as further described in Section 4.2.5, HI-5. The analytical methodology and assumptions, described in these documents, are conservative and consistent with DOE-STD-3009-94, *Preparation Guide for U.S. Department of Energy Nonreactor Nuclear Facility Documented Safety Analyses*(25), and DOE-HDBK-3010-94, *Airborne Release Fractions/Rates and Respirable Fractions for Nonreactor Nuclear Facilities*(34). The hazard and accident analysis methodology was developed using the guidance in HNF-8739**,** *Hanford Safety Analysis and Risk Assessment Handbook*(35) (SARAH) and DOE-STD-1189. SARAH guidance is consistent with DOE-STD-3009. The release source terms are consistent with DOE-HDBK-3010 for all DBAs except for the spray release modeling, which applied the Hanford SPRAY code methodology and SARAH guidance. See Recommendation 4-1 in Section 4.3 for further discussion.

The safety related SSCs were classified using the guidance from DOE-STD-1189 Appendices A through D, and the DOE-STD-3009 Safety Class and Safety Significant criteria.

Safety functions and the associated preliminary set of safety SSCs are documented in the Control Decision Report PRC-STP-00161. The safety functions were derived from the hazard and accident analyses.

4.2.2 HI-2

The controls strategies for DBAs are clearly identified in the hazard analysis, and include required safety functions and classifications. Controls were identified through a hazards analysis, accident analysis, and control decision process. The hazards analysis (PRC-STP-00124) used a What-If/Checklist methodology to systematically identify and evaluate hazards posed by the process, natural phenomena hazard (NPH), and external events. The accident analysis (PRC-STP-00154) quantified the consequences of DBAs using conservative parameters for material-at-risk, airborne release fraction/respirable fraction, dose conversion factors, and dispersion estimates to receptors. Based on the results from the accident analysis and applying the evaluation criteria in Appendices A, B, and C of DOE-STD-1189, controls were selected (PRC-STP-00161) consistent with the control selection order of preference provided in DOE-STD-1189.

The SDS specifies application of the prevention/mitigation preferences of DOE-STD-1189, "Safety Design Guiding Principles," Item # 2. The same order of preference is identified in PRC-STP-00161, Section 4.1, "Control Decision Methodology". The CSDR Section 4.4 "Preliminary Selection and Classification of Safety Structures, Systems, and Components" presents the control decisions and discusses the controls in the context of the order of preference (e.g., primary containment provides an engineered, preventive control; secondary containment provides a mitigative engineered controls located close to the hazard, etc.).

SSCs and a preliminary identification of potential Specific Administrative Controls have been identified to perform the identified safety functions as shown in Tables 4-19 through 4-26 of the CSDR.

As discussed in CSDR Section 4.4.4, "Natural Phenomenon Hazards," the DBA control strategy for non-seismic NPH specifies Performance Category 2 for wind and snow/ashfall loadings. See Recommendation 5-1 in Section 5.3 for further discussion.

For major SSCs, the control strategy specifies a seismic design basis of SDC-3. In accordance with the guidance in DOE-STD-1189, Limit State D has been conservatively applied. See Observation 4-2 in Section 4.3 for a further discussion.

4.2.3 HI-3

Adequate design information and operational concepts were provided to the hazards analysis process for the evaluation of alternatives, and the further evaluation of the preferred alternative. The attendance at hazard analysis meetings shows broad participation from the Safety Design Integration Team and other subject matter experts as necessary. Process flow diagrams and P&IDs were provided to and used in the hazard analysis and are shown in Appendices A and F of the PRC-STP-00124 Hazards Analysis[29].

The material-at-risk (MAR) was developed using the guidance in SARAH. SARAH guidance is consistent with DOE-STD-3009 and DOE-STD-1189 to establish a "reasonably conservative" bounding estimate for conceptual design. The conservatism of the safety basis inventory for MAR estimates was further reviewed by the TIPR, as summarized next.

K Basin sludge is segregated into KE floor sludge, KW floor sludge and settler sludge. Settler sludge consists of size-segregated material from fuel, canister, and scrap cleaning and has the highest concentration of radionuclides of the K Basin sludges. Current safety basis radioisotopic source term values are derived from characterization of sludge samples taken from eighteen KE fuel canisters and nine KW canisters in 1996. Mean values of isotope concentrations were calculated separately for the KE and KW canisters. The safety basis radioisotopic source terms for KW and KE are the upper limit of either a one sided 95,99 tolerance interval (there is a 95% confidence that 99% of the analyte concentrations lie below the calculated value) or, if the distribution is nonnormal, the upper limit of a one sided 95,95 tolerance limit is based on a lognormal distribution. The final safety basis settler radioisotopic source term values are based on a 50:50 by volume mixture of KE and KW canister sludges(36).

Settler sludge is in the process of being transferred from the settler tubes to EC-230. Final safety basis radioisotopic source term values will be based on samples taken from EC-230. Sampling of EC-230 is scheduled to begin summer 2010, and characterization is scheduled to be completed by July 2011.

The current safety basis radioisotopic source term values are deemed to be conservative because:

1. They are based on a 50:50 mixture of KE and KW sludge canister sludge. The actual settler sludge composition is 60:40 KE:KW. KW canister sludge has higher radionuclide concentrations than KE canister sludge hence the 50:50 values are biased high.
2. The radionuclide concentrations found for the individual canister samples varied widely yielding a broad distribution of values and high value for the upper limits of the tolerance intervals. Most current safety basis radioisotopic values are 3-5 times the mean values(37). The passage of the canister sludges through the settler tubes, followed by the transfer to the EC-230, and the sampling process in EC-230 should not substantially change the mean but should greatly reduce the uncertainty in the analytical results, the upper limits of the tolerance interval, and the safety basis radioisotopic source term.

4.2.4 HI-4

The hazards analysis performed in the conceptual design phase identified the high cost safety functions and design requirements for the SSCs that will be included in the project. The safety functions and NPH criteria for the Modified KW Basin Annex and associated functional requirements are identified in the Control Decision Report PRC-STP-00161 and in the CSDR Section 4.4 "Preliminary Selection and Classification of Safety Structures, Systems, and Components."

There are no Safety Class SSCs associated with EC/ST Disposition Phase 1 activities.

Safety Significant SSCs include slurry transfer line inner and outer hoses/pipes, burst disk, ion exchange module (IXM) water check valve, leak detection system, Sludge Transport and Storage Container (STSC) active ventilation system and transfer service box active ventilation to prevent hydrogen explosion, argon gas purge, sludge quantity instrumentation, STSC and Sludge Transport System (STS) cask design features, and fire-rated construction, protection of ventilation ductwork, and building grounding. Potential Specific Administrative Controls for DBAs have also been identified.

The safety functions and associated functional requirements of Safety Significant SSCs are identified on tables in Section 4.4 of the CSDR.

As discussed in CSDR Section 7.3.2, "Design Basis Hydrogen Deflagrations," hydrogen deflagrations are prevented, in part, by active ventilation. During preliminary design the preferred method for preventing hydrogen deflagrations given a loss of power to the ventilation system will be selected. Implementation of options identified-to-date (e.g., safety-significant emergency standby power, use of the argon gas purging system) would not have a large cost or schedule impact.

As discussed in CSDR Section 7.3.3, "Design Basis Fires," the fire suppression system, which provides a layer of defense-in-depth, is classified as general service. See Recommendation 4-4 in Section 4.3 for further discussion.

The confinement strategy is a combination of active and passive confinement. Sludge retrieval and transfer activities in the existing KW Basin facility are conducted underwater with the exception of the ingress/egress pipes and hose-in-hose transfer lines which provide primary and secondary passive confinement. The modified KW Basin Annex confinement ventilation system provides a defense-in-depth function. See Recommendation 4-4 in Section 4.3 for further discussion.

The PHA did not explicitly identify a nuclear criticality as a hazardous condition resulting from the PRC-STP-00124 Hazards Analysis(29). However, the sludge stored in the six engineered containers in the K-Basin contains more than a minimum critical mass of fissile material such that an inadvertent nuclear criticality must be addressed. Subsequent to the hazard analysis meetings, a criticality safety evaluation (CSE) for the STP was performed and documented(38). No new calculations were performed for this CSE, but it showed that, with the exception of transporting the STSCs, criticality scenarios for the STP had been evaluated and bounded in the revision to previous CSE reports for collection and transfer of the sludge(39, 40). The criteria and basis for subcriticality was based on the guidance from the currently approved nuclear criticality safety program(41) and had a documented limiting k_{eff} value less than or equal to 0.98(42). These CSE reports concluded that for the operations evaluated a criticality accident was not credible for normal or credible abnormal events. Therefore a criticality alarm system was not required. Based on the scenarios evaluated in these CSERs, the similarity of the design and operations which bound the STP, and the fact that it is the same material, the conclusion that a criticality alarm system will not be needed for the STP is reasonably conservative and the risk associated with significant redesign due to the addition of new or different requirements is minimal.

It was recognized in the STP CSE that criticality evaluation for transportation of the STSC requires a limiting k_{eff} of 0.95 and that this value would likely be the limiting k_{eff} for T-plant as well. Though not part of the scope of Phase 1, criticality controls placed on transportation or storage could affect the limits on the STSC while it is being loaded with sludge. This could cause some redesign of the STSC or, more likely, a mass limit on the amount of material allowed in a STSC. In either event the STP Phase 1 design is reasonably conservative and the risk associated with significant redesign due to new or different requirements caused by a limiting k_{eff} of 0.95 is minimal.

4.2.5 HI-5

The PHA established an appropriate suite of Design Basis Accidents (DBAs) to define functional and performance requirements for the facility design. All of the hazards identified in the Hazard Analysis PRC-STP-00124 were considered to establish the facility-level DBAs. The relevant accident initiators considered for each facility-level design basis accidents are identified in the Accident Analysis PRC-STP-00154. Major DBAs include:

- Internally initiated fires were identified in the PRC-STP-00124 Hazard Analysis as initiators for the spray release and hydrogen deflagration DBAs. Refer to CSDR Section 4.3.3 “Fires”.
- Internally initiated explosions were identified in the PRC-STP-00124 Hazard Analysis, and are analyzed as DBAs in CSDR Section 4.3.2, “Explosions”. The explosions analyzed are (1) a hydrogen deflagration in an STSC, and (2) a hydrogen deflagration in the transfer line service box following a loss of primary containment. See Recommendation 4-2 in Section 4.3 for further discussion.
- Internally initiated loss of containment/confinement hazardous conditions were identified in the PRC-STP-00124 Hazard Analysis. The internally initiated loss of containment/ confinement DBA is addressed in CSDR Section 4.3.1 “Spray Releases”. A spray release is the bounding loss of containment/confinement scenario. Spills and STSC over-pressurization scenarios are analyzed in the supporting Accident Analysis PRC-STP-00154. See Recommendation 4-1 in Section 4.3 for further discussion.
- Internally initiated process upsets were identified in the PRC-STP-00124 Hazard Analysis as initiators for the loss of containment/confinement and explosion DBAs analyzed in CSDR Sections 4.3.1 "Spray Releases" and 4.3.2 "Explosions".
- The internally initiated nuclear criticality is addressed in CSDR Section 4.3.6 “Criticality.” The PHA in the PRC-STP-00124 Hazard Analysis did not explicitly identify a nuclear criticality as a hazardous condition resulting from the What-If questions. However, the sludge stored in the six engineered containers in the KW Basin contains more than a minimum critical mass of fissile material such that an inadvertent nuclear criticality must be addressed. Subsequent to the hazard analysis meetings, a criticality safety evaluation (CSE) for the STP was performed as documented in PRC-STP-00163, *Criticality Safety Evaluation for Engineered Container and Settler Sludge Retrieval, Transfer, Transportation and Interim Storage (Phase 1)*[38]. The conclusion of the CSE based on the analyses, was that it appears highly likely that the planned transfer of sludge will meet criticality safety requirements with only a few additional controls and limits for transportation. It is likely that a criticality alarm system will not be required.

- Externally initiated events identified in the PRC-STP-00124 Hazard Analysis include range fires, vehicle fires, and aircraft crashes. These may be initiators to spray releases and hydrogen deflagrations and their controls are addressed in the CSDR Section 4.3.5, “External Events”.
- NPH initiated events were identified in the PRC-STP-00124 Hazard Analysis, and are addressed in CSDR Section 4.3.4. “Natural Phenomena Design Basis Accidents.”

4.2.6 HI-6

The PRC-STP-00154 Accident Analysis and the CSDR Chapter 4.0, “Design Basis Accidents,” identify the facility-level events used to develop the hazardous release event evaluations. These cover all the facility-level DBAs identified in DOE-STD-1189, Section 4.2.

4.2.7 HI-7

The Hazard Analysis and Control Decision Report identifies candidate controls for each hazardous condition. For those events with consequences that do not lead to selection of Safety Class or Safety Significant controls, candidate controls are identified that provide a defense-in-depth function. Design staff participated in both the hazard analysis and control decision meetings as indicated in the attendance rosters appended to PRC-STP-00124 Hazard Analysis, and PRC-STP-00161 Control Decision Report. Multiple layers of defense-in-depth are provided to prevent or mitigate uncontrolled releases. For example, for sludge transfers from an engineered container to an STSC, safety-significant primary and secondary containment with leak detection and overpressure protection is provided. In addition, the Modified KW Basin Annex structure and HEPA-filtered ventilation system provide another layer of defense in depth.

4.3 Observations, Recommendations, and Conclusions

Observations

- **Observation 4-1**: The current safety basis radioisotopic source term values appear to be reasonably conservative.

  Discussion: The TIPR Team agrees with the Project that the current safety basis radioisotopic source term values appear to be conservative and will most likely be reduced when characterization of EC-230 settler sludge is complete. The Team also agrees that completion of characterization is a high priority for the Project, as final safety classification of several SSCs is dependent on the final source term values. See Section 4.2.3, HI-3 for a further discussion.

- **Observation 4-2**: HNF-36364 requires the RADIDOSE/GXQ unmitigated dose for the 100 m Collocated Worker dose for seismic design categorizations, in addition to the DOE-STD-1189 unmitigated dose perspective. Suggest re-evaluating the need to provide both estimates, and if it's not necessary, delete it from the procedure, the CSDR, the accident analysis calculation, and other documents.

Discussion: The CSVR Section 4.3.4.1 Seismic Event and the accident analysis calculation (PRC-STD-00154, Section 5.3.1 Seismic Event[30]) presents two estimates of unmitigated dose to the Collocated Worker at 100 m for the spray release and the hydrogen explosion, one based on the DOE-STD-1189 dispersion coefficient (X/Q) and the other based on the Hanford-specific 99.5th percentile worst sector X/Q from RADIDOSE/GXQ code that results in about a factor of 17 increase. These alternative estimates are only used for application of the HNF-36364, *Seismic Design Requirements Selection Methodology for the Sludge Treatment and M-91 Solid Waste Processing Facilities Projects*[43]; all other Design Basis Accidents apply the DOE-STD-1189 X/Q. DOE-STD-1189 Appendix A Section A.1 (page A-4) provides the recommended value for the selection of Seismic Design Categories, and this same value is cited in Section A.2 (page A-6) for the Safety Significant classification of SSCs (note: in both cases it states "For the purposes of this Standard"). This does not affect the current CD-1 basis since the most limiting SDC-3 Limit State D has been selected, and since the site seismic hazard curve will not be available for a few years, it may not be necessary if a lower seismic classification is not needed to proceed to preliminary design.

- **Observation 4-3**: The Waste Treatment Plant Project recently completed revising their methodologies and key assumptions for the evaluation of Design Basis Accidents (DBAs), which was approved by DOE-ORP. It is suggested that DBAs documented in 4590-PTF-Z0C-W14T-00036, *Severity Level Calculations for the Pretreatment Facility Based on Updated MAR*, that are similar to the spill, impact and over-pressurization DBAs evaluated for the STP CSDR, be reviewed to determine whether any key STP assumptions warrant revision.

Discussion: In response to a DOE-ORP-BNI initiative to update bounding estimates of Material at Risk (MAR) and to update modeling of all DBAs, the Waste Treatment Plant (WTP) Project has recently revised some of the methodologies and key assumptions as documented in 24590-PTF-Z0C-W14T-00036, *Severity Level Calculations for the Pretreatment Facility Based on Updated MAR*[44]. There are some differences between the WTP and STP CSDR methodologies and key assumptions related to the evaluation of spill, impact and over-pressurization DBAs. The overall impact is not believed to be sufficient to affect the preliminary determination of STP Safety Significant SSCs. However, it is suggested that the methodology differences be reviewed to determine whether any key STP assumptions warrant revisions. In particular, the justification for a 0.1 Damage Ratio assumption for an over-pressurization should be strengthened since this is not explicitly recommended in the DOE-HDBK-3010 methodology[34], but is appropriate considering the size of the STP vessel and the experimental basis for the DOE-HDBK-3010 recommendations.

- **Observation 4-4**: The STP methodology presented in the PRC-STD-00124 Hazard Analysis on Table 3-1 defines an offsite consequence threshold for a Low consequence as < 5 rem (50-yr Total Effective Dose). This value is not consistent with most hazard analysis methodologies previously used in the DOE Complex. It is suggested that this threshold for a Low consequence to the public be reviewed against the Hanford SARAH and earlier DOE-RL and guidance from DOE Standards to determine whether a change is warranted.

  Discussion: A footnote to PRC-STD-00124 Hazard Analysis Table 3-1 identifies that the < 5 rem Low consequence threshold is a departure from the Hanford SARAH guidance. The SARAH method was used for the hazards analyses for the two STP alternatives (PRC-STP-00012[(27)] and PRC-STP-00037[(28)]), and is more consistent with other DOE guidance (e.g., DOE-STD-1120-2005[(45)] and DOE-STD-5506-2007[(46)]) and the previous DOE-RL guidance (Klein and Schepens 2003 memo 03-ABD-0047[(47)]). A basis for this deviation is not provided.

- **Observation 4-5**: Based on the current CSE's, it appears that the planned transfer of sludge will meet criticality safety requirements with only a few additional controls and limits for transportation. It is likely that a criticality alarm system will not be required. The Phase 1 design is reasonably conservative with respect to criticality safety and the risk significant redesign is minimal.

  Discussion: See Section 4.2.4, HI-4.

Recommendations

- **Recommendation 4-1**: Consider replacing the STP CSDR method for spray releases with the Waste Treatment Plant (WTP) methodology documented in 24590-WTP-RPT-ENS-10-001, *WTP Methodology for Spray Release Scenarios*.

  Discussion: In response to the Defense Nuclear Facilities Safety Board (DNFSB) staff comments on the 2003 PDSA modeling of spray releases based on the DOE-HDBK-3010 methodology[(34)], the WTP Project recently revised their application of the Hanford SPRAY code methodology that applies a different correlation for the Sauter Mean Diameter (SMD) and also revised other key input assumptions, e.g., determining the size of the crack. An independent peer review team disagreed with the SPRAY correlation due to its inclusion of the crack hydraulic diameter in determining the SMD. It is recommended that the WTP methodology documented in 24590-WTP-RPT-ENS-10-001, *WTP Methodology for Spray Release Scenarios*[(48)], be considered to replace the STP CSDR method. This recommendation is being made since the STP postulated consequence to the public approaches the DOE-STD-1189 threshold for challenging the offsite Evaluation Guideline and could affect the determination of the need for Safety Class controls if consequences were much higher. However, based on the Tank Farm's scoping assessment of the impact of the WTP methodology which applied the SPRAY code slightly differently than STP did, it is anticipated that the radiological consequences will be less than predicted using the SPRAY code SMD correlation and STP input assumptions.

- **Recommendation 4-2**: Review the Waste Treatment Plant methodology for explosions in vessels documented in 24590-PTF-Z0C-W14T-00036, *Severity Level Calculations for the Pretreatment Facility Based on Updated MAR*, and determine whether any key STP assumptions warrant revisions.

  Discussion: In response to a DOE-ORP-BNI initiative to update bounding estimates of Material at Risk (MAR) and to update modeling of hydrogen and nitrous oxide explosions in vessels and in piping and ancillary vessels, the WTP Project has recently revised their methodology. It is recommended that the WTP methodology of explosions in vessels documented in 24590-PTF-Z0C-W14T-00036, *Severity Level Calculations for the Pretreatment Facility Based on Updated MAR*(44), be reviewed to determine whether any key STP assumptions warrant revisions. This recommendation is being made since the STP postulated consequence to the public approaches the DOE-STD-1189 threshold for challenging the offsite Evaluation Guideline and determination of the need for Safety Class controls. However, since both models are based on the DOE-HDBK-3010 approach, the radiological consequence estimates calculated using the WTP methodology are not anticipated to be significantly different and may even be slightly lower.

- **Recommendation 4-3**: Resolve the issue of the appropriate site boundary as soon as possible.

  Discussion: The DNFSB site representative has recently questioned the application of the Hanford site boundary for all DOE-RL safety basis documents. The STP CSDR and supporting accident analysis are based on the same site boundary as used for the existing K-Basins safety basis and all other DOE-RL nuclear facilities, which extends across the Columbia River. This issue warrants resolution as soon as possible since it would drive Safety Class control designations due the substantial increase in unmitigated consequences associated with reducing the site boundary to the near bank of the Columbia River. This is not identified as in the CSDR in the Chapter 7 risk and opportunity, but need not be included at this time. This issue not only affects the STP and all other new projects under development, but impacts the safety basis for existing DOE-RL nuclear facilities.

- **Recommendation 4-4**: Document justifications for not selecting the Confinement Ventilation System and the Fire Suppression and Alarm Systems as Safety Significant SSCs for DOE-RL concurrence prior to the approval of CD-1.

  Discussion: Although the Confinement Ventilation System (CVS) is being designed to the DOE Order 420.1B, *Facility Safety*(49) requirements, the guidance in DNFSB Recommendation 2004-2 CVS evaluation report(50) does not appear to have been considered. In addition, recent guidance has been issued on fire suppression and water supply in response to DNFSB recommendation 2008-1. It is not apparent how the guidance from DOE-STD-1189 Section D.2, "Criteria for Selecting SS Major Contributors to Defense-in-Depth", was applied.

Although no longer applicable since the issuance of DOE-STD-1189 and the April 15, 2009 DOE Environmental Management memorandum from James Owendoff(51), the July 2006 EM Interim Design Guidance for new facilities provided the following DOE expectations(52):

> "At the CD-1 stage of the design the primary focus is on determining an initial list of safety SSCs based on the type and magnitude of radioactive materials and the level of protection needed for workers and the public. This initial list is important so that preliminary design criteria can be established and provided to architects/engineers at the preliminary design stage that begins upon approval of the CD-1 package. The initial determination of safety SSCs must be conservative given the negative implications of having to modify the design to accommodate additional safety SSCs or higher design pedigrees at later stages of design maturity. The initial safety SSC list can be refined (i.e., enhanced safety margin) or sometimes reduced, with maturity of the hazard and accident analysis at later stages of design. This iterative approach is consistent with the traditional deterministic nuclear design philosophy where the safety analysis is used to confirm that the selected design standards and parameters would yield the expected high performance of safety and reliability as the design matures.
>
> It is expected that Hazard Category 2 facilities, or Hazard Category 3 facilities with potential for significant onsite radiological consequences have robust engineering features to provide protection of the public and onsite populations. These type of facilities should, at a minimum, select fire protection (detection and suppression), confinement ventilation systems (CVS), and nuclear criticality design features or/and alarms (if the fissile material inventory poses criticality potential) as safety SSCs. These systems shall meet nuclear safety design criteria as required by DOE O 420.lB. In addition, any facility CVS shall meet the Performance Criteria specified in DNFSB Recommendation 2004-2 Implementation Plan Document 'Ventilation System Evaluation Guidance for Safety-Related and Non-Safety-Related Systems' Table 5-1, or later successor criteria."

The STP Project has not continued with the above EM guidance for a CD-1 phase as related to the expectations for the cited four safety systems which were not designated as Safety Significant SSCs. The preliminary criticality safety evaluation PRC-STP-00163(38) provides a basis for the prediction that a criticality alarm system should not be required and has identified preliminary Safety Significant controls, therefore, this expectation has been met. See Section 4.2.4, HI-4, for a further discussion.

The importance of the other three systems in terms of being a major contributor to defense in depth is not readily understood from the safety basis documentation in the CSDR, the PRC-STD-00124 Hazards Analysis, and the PRC-STD-00161 Control Decision Report. The CVS and the fire suppression system are identified as available mitigative controls, however, since they were not selected as Safety Significant, there are no control selection discussions that documented why they were not selected. It is not apparent how the DOE-STD-1189 Section D.2 guidance on major contributor to defense in depth was applied to them, recognizing that the complete control set was established as described in Section D.1, "Selection and Classification of a Complete Control Set", using a judgment-based process involving many factors, such as effectiveness, a general preference of preventive over mitigative and passive over active, relative reliability, and cost considerations.

The CSDR Section 7.3.1 Design Basis Spray Releases acknowledges the Modified KW Annex CVS as providing another layer of defense in depth and states that it is not anticipated that the general service classification will change during preliminary and detailed design. Therefore, significant cost and schedule impacts are not anticipated. This risk is further discussed in the PRC-STP-00164 Risk and Opportunity Assessment[(53)]. The KW Annex CVS consists of three major subsystems: (1) the STSC active ventilation system for loading the STC (Zone 1); (2) the transfer line service box ventilation system (Zone 2, which also services the decant pump box, sand filter vault and annulus of the hose-in-hose or pipe-in-pipe transfer lines); and (3) the tertiary CVS that provides active ventilation and high efficiency particulate air (HEPA) filtration of the Modified KW Annex occupied areas. The first two subsystems have been designated as Safety Significant SSCs to provide dilution to maintain less than 25% of the Lower Flammability Limit to prevent hydrogen explosions, and will be designed to seismic SDC-3, Limit State D. The spray accident relies on a passive confinement strategy consisting of sludge retrieval under water, the slurry line primary piping or hose boundary and slurry transfer line secondary boundary (outer pipe or hose), the transfer line service box, and the Sludge Transfer and Storage Container (STSC). No accident credited a HEPA filtration leak path factor. Although the KW Annex CVS is being designed to the DOE Order 420.1B requirements, the guidance in the above cited DNFSB Recommendation 2004-2 CVS evaluation report does not appear to have been considered for the active confinement function of the CVS during the conceptual design. Per Section 3.3.1.1, "Confinement Strategy", of the SDS, it states that "Required confinement ventilation systems shall be designed in accordance with the applicable performance criteria specified in Defense Nuclear Facilities Safety Board Recommendation 2004-2 Implementation Plan Document[(50)] (Black, 2006, 'Ventilation System Evaluation Guidance for Safety-Related and Non-Safety Related Systems') or later criteria. Bases for any proposed exemptions from the performance criteria shall be documented." Therefore, the expectation is that as preliminary design of the ventilation system design progresses, the applicable design criteria from the referenced report will be considered.

It should also be noted that the existing 105-KW Basin facility does not have a secondary CVS with HEPA filtration. The basin superstructure is directly vented to the atmosphere and is not well sealed, so it was not credited in the current safety basis to provide a confinement boundary. The primary confinement system used to prevent an uncontrolled release of radioactive material from the sludge in the basin is the water contained by the basin water boundary to prevent aerodynamic entrainment and release. Other temporary primary confinement systems have been previously used during the removal of fuel from the basins or use of the Safety Significant hose-in-hose transfer system for retrieval of sludge from the KE Basin

The CSDR Section 7.3.3 Design Basis Fires addresses the fire suppression system as follows (fire alarm system is not addressed):

> "Based on the above described control strategy, the Modified KW Basin Annex fire suppression system, which provides yet another layer of defense-in-depth, has been classified as general service. If this classification were to change to safety significant during preliminary and detailed design, there would not be large cost and schedule impacts specific to the fire suppression system itself. However, it would also be necessary to upgrade the fire water supply system to safety significant. If this upgrade could be accomplished by commercial grade item dedication, then there would not be large cost and schedule impacts. If the system could not be upgraded via the commercial grade item dedication process, then there would large cost and schedule impacts."

The fire suppression and alarm systems are addressed in the PRC-STP-00171, *Sludge Treatment Project Engineered Container Retrieval and Transfer System Conceptual Design Fire Hazards Analysis* [54], along with the strategy to comply with the DOE Order O 420.1B design requirements. However, in response to the DNFSB Recommendation 2008-1, two evaluation reports were recently issued for fire suppression systems and fire water supply for those designated as Safety Significant or Safety Class. Based on the risk and opportunity discussion, in anticipation that the fire suppression system could be designated as Safety Significant as the design and safety analysis proceeds, any potential impacts from this new guidance should be considered at this time.

Therefore, it is recommended that justifications for not selecting the active confinement function of the Modified KW Annex CVS and the fire suppression and alarm systems as Safety Significant SSCs be developed prior to CD-1 approval.

Conclusions

The STP Hazards Analysis and Accident Analysis were developed per the guidance from DOE-STD-1189, including evaluating alternatives, and provide the expected level of detail necessary to support CD-1 decisions. The level of detail of the STP hazards and accident analysis to support the CSDR is perhaps more than what may be available for other projects since the process hazards and control strategy associated with STP transfers have previously been evaluated. Therefore, appropriate lessons learned have been applied. The quantitative STP Accident Analysis of facility-level Design Basis Accidents provides a sound technical basis for the selection of Safety Significant SSCs at CD-1, which was supplemented with the additional Safety Significant criteria from the Hazards Analysis results. Overall, the hazards analysis, accident analysis, and control decision report establish the safety functions and functional requirements for determination of Safety Significant SSCs and potential TSR Specific Administrative Controls, and provide a solid foundation for the safety analysis and preliminary design to proceed. Issues that require resolutions to further support the safety basis for conceptual design are identified in the preceding recommendations; observations listed above should also be considered by the Project.

5 Conceptual Safety Design Report / Conceptual Safety Validation Report

5.1 Introduction

The following Line of Inquiry (LOI) was developed to address the adequacy of the Conceptual Safety Design Report (CSDR) / Conceptual Safety Validation Report (CSVR) to support the conceptual design, and application of guidance from DOE-STD-1189-2008, *Integration of Safety in the Design Process*[13]:

CR-1 Does the CSDR meet the format and guidance criteria in DOE-STD-1189, Appendix H?

Additional details of this LOI and their responses are documented in Appendix A, Table A-3, "Conceptual Safety Design Report (CR)". This section provides the overall assessment regarding adequacy of the CSDR/CSVR to support the conceptual design.

5.2 LOI Results

5.2.1 CR-1

The EC/ST Disposition Phase 1 CSDR is documented in PRC-STP-00156, *Sludge Treatment Project Conceptual Safety Design Report*[32]. It meets the format and guidance criteria in DOE-STD-1189, Appendix H, "Conceptual Safety Design Report". It includes major sections that provide a description of the sludge retrieval mission, facility and processes, preliminary hazards analysis, design basis accidents, Safety Significant SSCs, security hazards and design implications (covered in Section 8 of this report), facility safety design criteria, planned studies or analyses, safety-in-design risks and opportunities, and lessons learned from previous experience.

A preliminary hazard analysis is included as Appendix A to the CSDR. It was developed per the guidance from DOE-STD-1189, Appendix G, "Hazards Analysis Table Development", based on the PRC-STD-00124 STP Hazards Analysis[29], PRC-STD-00154 Accident Analysis[30], and the PRC-STD-00161 Control Decision Report[31].

The safety functions and associated functional requirements of Safety Significant SSCs are identified on tables in Section 4.4 of the CSDR.

The EC/ST sub-project has committed to follow all the applicable requirements of DOE O 420.1B, *Facility Safety*[49]. The CSDR Table 6-1, "Approach to Meeting the Requirements of DOE O 420.1B", lists the design requirements of CRD O 420.1B (DOE O 420.1B, Attachment II), Chapters I and IV, and identifies those that are applicable. These requirements have been updated as appropriate by the DOE-RL supplement to DOE O 420.1B (SCRD, Revision 4) as listed in the Plateau Remediation Contract. Table 6-1 also describes the approach to implementing each requirement. No exemptions to design requirements are planned, nor has the need for equivalencies been identified.

The STP Project documented its formal design review in PRC-STP-00207, *Sludge Treatment Project Formal Design Review Report for the Conceptual Design of the Engineered Container Retrieval and Transfer System*(55). Comments were formally documented on Review Comment Record (RCR) forms. These comments were prioritized regarding resolutions that needed to be completed prior to submittal of the CD-1 package, or those that can be resolved after submittal. Appendix B to that report includes the updated "Engineered Container Retrieval and Transfer System, Design Requirements Matrix" that documents the assessment of meeting specific design requirements.

The DOE-RL Safety Basis Review Team (SBRT) has completed its review of the CSDR and supporting documents and is in the process of drafting the CSVR using the guidance from DOE-STD-1104-2009, *Review and Approval of Nuclear Facility Safety Basis and Safety Design Basis Documents*(56). Other than incorporating the agreed-to resolutions to the SBRT review comments, no Conditions of Approval to resolve specific issues have been identified. The SBRT plans to recommend approval of the CSDR to the DOE-RL Approval Authority.

5.3 Observations, Recommendations, and Conclusions

Observations

- **Observation 5-1**: As a Preliminary Safety Design Report (PSDR) will not be prepared for this project, it is suggested that a short discussion of the Hazards Analysis and control decision results using the format and content of the DOE-STD-1189 Appendix I PSDR/PDSA Section 3.3 "Hazard Analysis Results" be added to the CSDR. This would facilitate a better understanding of how the DOE-STD-3009 Safety Significant SSC criteria on major contributors to defense-in-depth and/or worker safety were applied.

  Discussion: The results of the PRC-STD-00124 STP Hazards Analysis(29) and how it was used for the PRC-STD-00161 control decision report(31) are not summarized in the CSDR based on the format and content specified in DOE-STD-1189 Appendix H, "Conceptual Safety Design Report". Since a Preliminary Safety Design Report (PSDR) will not be prepared for this project, due to the tailored CD-2/3 approach as allowed by DOE Order 413.3A(10), Table 2, "Critical Decision Requirements" it is suggested that a short discussion of the Hazards Analysis and control decision results be added to the CSDR using the format and content of the DOE-STD-1189 Appendix I, PSDR/PDSA Section 3.3 "Hazard Analysis Results", would be beneficial to understand how the DOE-STD-3009(25) Safety Significant SSC criteria on major contributors to defense-in-depth and/or worker safety were applied. Since no PSDR is planned for the project, this high-level summary can provide readers of the CSDR with the overall perspective on how Safety Significant SSCs were selected based on the DOE-STD-1189 guidance considering Collocated Workers, Facility Workers, chemical hazards, and major contributors to defense-in-depth (i.e., Appendices A through D). It also provides the opportunity to address other defense-in-depth SSCs that are equipment important to safety, e.g., the building confinement ventilation system, fire suppression system, fire alarm system, lightning protection system, etc. It is understood that identification of defense-in-depth SSCs will be developed for the PDSA, however, earlier identification of the most important defense-in-depth SSCs could be accomplished for the CSDR.

Recommendations

Recommendation 5-1: The basis for the Performance Category 2 determination for compliance with DOE Order O 420.1B for high winds, snow loading, ashfall loading, and flooding should be documented.

Discussion: A Performance Category 2 was selected for compliance with DOE Order O 420.1B, *Facility Safety*[(49)] for high winds, snow loading, ashfall loading, and flooding. The Engineering procedure PRC-PRO-EN-097, *Engineering Design and Evaluation (Natural Phenomena Hazard)*[(57)], is referenced in the design media. However, the basis for the decision for this selection using the DOE-STD-1020-2002, *Natural Phenomena Hazards Design and Evaluation Criteria for Department of Energy Facilities*[(58)], and DOE-STD-1021-93, *Natural Phenomena Hazards Performance Categorization Guidelines for Structures, Systems, and Components* [(59)], guidance is not documented.

Conclusions

The CSDR has been developed per the guidance from DOE-STD-1189, Appendix H, and provides the expected level of detail necessary to support CD-1 decisions. As stated in Section 4.3 of this report, the hazards analysis, accident analysis, and control decision report establish the safety functions and functional requirements for determination of Safety Significant SSCs and potential TSR Specific Administrative Controls; these have been adequately captured in the CSDR. The CSDR and supporting documentation provide a solid foundation for the safety analysis and preliminary design to proceed. Issues that require resolutions to further support the safety basis for conceptual design are identified in the preceding recommendations; observations listed above should also be considered by the Project.

6 Risks to Project Safety Decisions

6.1 Introduction

The following Line of Inquiry (LOI) was developed to address the risks to project safety decisions, and application of guidance from DOE-STD-1189-2008, *Integration of Safety in the Design Process*[(13)]:

PR-1 Has the Safety-in-Design Risk and Opportunity Assessment been developed?

Additional details of this LOI and their responses are documented in Appendix A, Table A-4, "Risks to Project Safety Decisions (PR)". This section provides the overall assessment regarding adequacy of identifying these risks to project safety decisions to support the conceptual design.

6.2 LOI Results

6.2.1 PR-1

A Safety-in-Design Risk and Opportunity Assessment has been developed and is documented in PRC-STP-00164, *Sludge Treatment Project Engineered Container Retrieval and Transfer System Risk and Opportunity Assessment*[(53)]. It considered the checklist from DOE-STD-1189, Appendix F, "Safety-in-Design Relationship with the Risk Management Plan". The STP hazard and accident analysis results were also considered as documented on PRC-STP-00164, Table 1 "Evaluation of Candidate Design Risks from DOE-STD-1189, Table F-1", and Table 2, "Evaluation of Candidate Technology Risks from DOE-STD-1189, Table F-1".

These risks and opportunities are also summarized in the Section 7.2, "Safety-in-Design Risks and Opportunities", of the PRC-STP-00156, *Sludge Treatment Project Conceptual Safety Design Report* (CSDR)[(32)].

Risk management strategies are identified on the PRC-STP-00164 Tables 1 and 2 and described in the text. These are summarized in the CSDR Section 7.1, "Planned Studies or Analyses". Seven areas of further studies or testing are indentified and are summarized in the CSDR Section 7.2, "Safety-in-Design Risks and Opportunities".

The PRC-STP-00166, *CD-1 Report for the Sludge Treatment Project Engineered Container Retrieval and Transfer System*[(60)], Section 3.2.11 "Risk and Opportunity Assessment", acknowledges that PRC-STP-00164 is input to the STP Risk Management Plan.

6.3 Observations, Recommendations and Conclusions

Observations

There are no observations on this LOI.

Recommendations

There are no recommendations on this LOI.

Conclusions

Safety-in-design risks and opportunities have been identified and documented. The CD-1 report acknowledges its input to the STP Risk Management Plan.

7 Safety Design Integration Team – Interfaces and Integration

7.1 Introduction

The following Lines of Inquiry (LOIs) were developed to address the adequacy of the Safety Design Integration Team (SDIT) interfaces and integration with the design project, and application of guidance from DOE-STD-1189-2008, *Integration of Safety in the Design Process*(13):

- II-1 Does the Safety Design Integration include the interface organizations and activities identified in Table 7-1 of DOE-STD-1189 as appropriate?
- II-2 Do the interfaces include appropriate safety disciplines / subject matter experts?
- II-3 Do these interfaces address the appropriate resource requirements and guidance as identified in Table 7-1?

Additional details of these LOIs and their responses are documented in Appendix A, Table A-5, "Safety Design Integration Team – Interfaces and Integration (II)". This section provides the overall assessment regarding adequacy of SDIT interfaces and integration to support the conceptual design.

7.2 LOI Results

7.2.1 II-1

The safety design integration includes the interface organizations and activities identified in Table 7-1, "Typical Actions Associated with Project Life-Cycle Stages", of DOE-STD-1189 as related to conceptual design. Interface organizations and activities are identified in the STP Safety Design Strategy (SDS)(19), Section 6.0 "Safety-in-Design Integration Team – Interfaces and Integration", and in the SDIT charter HNF-35063, *Sludge Treatment Project Safety Design Integration Team Charter*(61). The PRC-STP-00111, *STP Contractor Integrated Project Team Charter* (CIPT)(62), identifies core membership that includes some of the SDIT members. Interfaces extend beyond the SDIT and CIPT as identified in the PRC-STP-00166, *CD-1 Report for the Sludge Treatment Project Engineered Container Retrieval and Transfer System*(60), Chapter 3 "Conceptual Evaluations".

7.2.2 II-2

The SDIT interfaces include appropriate safety disciplines / subject matter experts. These are identified on the SDIT charter Table 1 "Safety Design Integration Team Core Membership". SDIT and other safety disciplines are specifically identified on the CIPT charter Table 1, "CIPT Core Membership".

DOE-RL has defined the roles, responsibilities, and organizational relationships of the federal staff in the *Sludge Treatment Project, Federal Integrated Project Team Charter* (FIPT)[63] that are necessary for the success of the project. Other non-DOE external reviews are defined in the FPIT charter.

The Project documented its formal design review in PRC-STP-00207, *Sludge Treatment Project Formal Design Review Report for the Conceptual Design of the Engineered Container Retrieval and Transfer System*[55]. Comments were formally documented on Review Comment Record (RCR) forms. These comments were prioritized regarding resolutions that needed to be completed prior to submittal of the CD-1 package, or those that can be resolved after submittal. Appendix B to that report includes the updated "Engineered Container Retrieval and Transfer System, Design Requirements Matrix" that documents the assessment of meeting specific design requirements.

The DOE-RL *Sludge Treatment Project, EC/ST Disposition Sub-project Phase I, Critical Decision – 1 Readiness Plan*[64], defines the DOE-RL review plan to provide the assurance for adequacy of the design, technical, and project management information needed to support CD-1 decisions. The FDIT interacts with the CDIT and SDIT on a routine basis, and via formal reviews at appropriate milestones. For example, the draft CD-1 report and key supporting documents were reviewed by the FDIT and their comments and responses were formally documented on RCRs. In addition, the CSDR and supporting documentation are being reviewed by the DOE-RL Safety Basis Review Team, which has concluded that a recommendation for approval will be provided to the DOE-RL Approval Authority.

7.2.3 II-3

The extent of safety basis documentation and the CD-1 report indicate that sufficient staff resources have been made available to support the SDIT and CIPT as defined in those charters.

7.3 Observations, Recommendations, and Conclusions

Observations

There are no observations on this LOI.

Recommendations

There are no recommendations on this LOI.

Conclusions

The STP Project and DOE-RL have defined the roles, responsibilities, and organizational relationship needed for success of the project and defined them in respective charters for the SDIT, CIPT, and the FIPT. To date, adequate staffing has been provided to support the CD-1 package deliverables, including the CSDR.

8 Transportation Safety

8.1 Introduction

DOE STD 1189 does not include a transportation and packaging (T&P) safety basis. Each DOE site is responsible for the development of a site-specific transportation safety basis. The *Hanford Transportation Safety Document* (TSD), DOE-RL-2001-36(14), defines the onsite T&P program for the Hanford Site and complies with the U.S. Department of Energy (DOE) transportation safety requirements specified in DOE Order 460.1B, Packaging and Transportation Safety. This DOE-RL approved TSD is the onsite documented safety analysis (DSA) for T&P activities. The TSD complies with the safe harbor methodology prescribed in Title 10 Code of Federal Regulations (CFR) 830, "Nuclear Safety Requirements," documenting compliance with the nuclear safety rule for T&P activities.

The TSD meets the requirements of DOE Order 460.1B and 10 CFR 830 and provides a level of onsite safety equivalent to that achieved offsite under U.S. Department of Transportation (DOT) regulations provided in 49 CFR Subchapter C, "Hazardous Materials Regulations," and U.S. Nuclear Regulatory Commission (NRC) standards provided in 10 CFR 71, "Packaging and Transportation of Radioactive Material." The TSD is the controlling document for transportation safety for the Hanford Site.

The TSD is implemented by each of the DOE prime contractors on the Hanford site through their company administrative and operational procedures. PRC-RD-TP-7900, *Transportation and Packaging Program Requirements*(65), is the CHPRC level 2 requirements document that identifies T&P program requirements. The document provides a crosswalk between the DOE Order Requirements and the Contractor Requirement Documents and outlines organizational responsibilities. PRC-PRO-TP-15665, *Transportation Safety Basis Documents*(66), is a CHPRC level 2 management control procedure used to provide the requirements and processes for the development of Package Specific Safety Documents (PSSDs), One-Time Request for Shipments (OTRSs), Special Packaging Authorizations (SPAs) and SPA Shipment Evaluation Checklists (SPA-SECs). Appendix I, *Special Packaging Authorization*, of the TSD (Revision 1-C) was up-dated to include the Fuel-SPA (F-SPA) that would authorize the transport of K-Basin sludge under specific conditions. Shipments under the F-SPA are authorized with the submittal and approval of a F-SPA checklist.

The Sludge Treatment Project (STP) transportation safety requirements are implemented by PRC-STP-00200, *Sludge Treatment Project Engineered-Containers Transportation Safety Documentation Plan*(67). The plan outlines the approach to be used to develop the transportation safety documents that will be used to authorize use of the Sludge Transport System (STS) to transport K-Basin sludge on the Hanford site. The STS is an existing system previously used to transport sludge from K-Basin to T-Plant. As listed in Table 2, *Hanford Site (Onsite) Equivalent PSSDs*, of the TSD the STS is approved for use on-site under the conditions prescribed in the

STS-PSSD (SNF-10823[68]). However, due to changes to the STS payload container and proposed payload the STS cannot be used to transport the EC/ST sludge inventory under the existing authorization document.

PRC-STP-00213, *Determination if a New Transportation Safety Document is Necessary for the Transport of the K-East Engineered Container Sludge*[69], is one of a number of decisional transportation safety documents identified in PRC-STP-00200[67] that are needed to evaluate, determine, and develop the type of transportation safety document to be used to authorize the STS/STSC transports required – PSSD, OTRS, or F-SPA Checklist. PRC-STP-00213[69] concludes the KE containerized sludge is not authorized under the current STS PSSD and the Fuel-SPA (F-SPA) conditions are too restrictive to efficiently transport the sludge with the STS/STSC. The remaining transportation safety documents are scheduled in accordance with PRC-STP-00200[67].

8.2 LOI Results

8.2.1 TS-1

The overall approach to develop and approve transportation safety documents for the transfer of sludge to T-Plant is appropriate for the STP conceptual design. The existing procedural controls are sufficient to ensure compliance with the TSD.

The EC/ST Disposition Phase 1 project plans to transport packaged sludge in the existing STS cask with a newly designed payload container called the Sludge Transport and Storage Container (STSC). The STSC will replace the original STS payload container, called the Large Diameter Container, or LDC, and utilize the remainder of the system for transport.

The STS was specifically designed and built to transport large quantities of sludge with Type-B quantities of activity from the K-Basin to T-Plant. The STS was originally authorized to transport a 60% to 40% by volume mixture of KE Basin floor and canister sludge packaged in the LDC. The change in ECTRS sludge characteristics and proposed use of the STSC require a new or revised transportation safety document.

8.2.2 TS-2

The conceptual design for transportation safety is based on conservative assumptions and analyses that are consistent with the Criticality Safety Evaluation Report (CSER) for the planned waste packaging.

A preliminary criticality safety evaluation was performed utilizing the safety basis values for each of the EC/ST sludge sub-populations (PRC-EDC-10-44264[38]). The scope of this evaluation included the loading of the sludge into the STS/STSC at K-Basin, the transport of the sludge from K-Basin to T-Plant using the STS/STSC, and the interim storage of the full STSCs at T-Plant. The report concluded that the transport of the EC/ST sludges in the STS/STSC did not introduce any new scenarios that were not already bounded by previous CSERs.

Conditions to be evaluated and demonstrated as safe per the TSD in the new CSER were presented and approved by DOE-RL Safety and Engineering Division (SED) in Criteria for Criticality Safety Evaluation CSER Supporting Site Shipment of K Basin Sludge, Jan. 2010[(70)].

PRC-STP-00200, *Sludge Treatment Project Transportation Safety Basis Document Plan*[(67)], requires a new CSER performed and included in the STS transportation safety document. The CSER will also utilize conditions representing the highest activity sludge and the maximum sludge loading conditions.

8.2.3 TS-3

The conceptual design for transportation safety is based on conservative assumptions and analyses that demonstrate planned shielding will achieve compliant dose rate limits established in the transportation safety basis.

Preliminary/screening shielding calculations (PRC-STP-00102[(71)]) were performed with the worst-case sludge activities (Settler tube sludge safety basis values) and loading conditions. The dose rates associated with the transport of the sludges will be within the TSD allowable limits.
PRC-STP-00200, *Sludge Treatment Project Transportation Safety Basis Document Plan*[(67)], requires new shielding calculations be performed and included in the STS transportation safety document. Ultimately, compliance will be demonstrated by actual dose rate measurements on the loaded cask.

8.2.4 TS-4

The conceptual design for transportation safety is based on conservative assumptions and analyses that demonstrate expected hydrogen gas and heat generation values will not exceed the gas generation and thermal limits established in the transportation safety basis.

Preliminary gas and thermal evaluations have been performed using the safety basis inventory values (PRC-STP-00220[(72)]) and the results of the gas and thermal evaluation are discussed in HNF-41051. These conservative evaluations indicate that gas and thermal conditions may limit the amount of Settler tube sludge placed into the STS/STSC, while the K-East and K-West sludge inventories will not be limited by gas and thermal conditions.

Sludge Treatment Project Transportation Safety Basis Document Plan[(67)], requires new gas and thermal calculations to be performed and included in the STS transportation safety document.

8.3 Observations, Recommendations, and Conclusions

- **Observation 8-1:** As with many complex activities in the conceptual design phase, the transportation safety documents associated with the STS are still generic and target the high level activities only. Detailed information supporting the transportation safety documents have not yet been fully compiled or assimilated into a single coherent document that will become the basis for a PSSD, OTRS or F-SPA checklist. A PSSD, OTRS or F-SPA is the DSA for transportation and requires the same level of detail as the hazard classification of a facility. The modifications to the STS will require major changes to the existing or new PSSD.

- **Observation 8-2:** The quality, detail, and effort put into prototyping the system was excellent and well thought out. By the time the Project gets to the actual packaging operation most of the system interface issues will be resolved.

- **Recommendation 8-1:** The PSSD, OTRS or F-SPA checklist is the principal transportation safety document used to determine if the package provides an equivalent degree of safety to the Type B specification. The PSSD, OTRS or F-SPA checklist should be drafted as early as possible during the project to allow for all the reviews and analysis required for a DSA.

Conclusion: The transportation safety documentation supporting the STP Phase 1 conceptual design is conservative and bounding and the applicable controls are appropriate to support transporting STP sludge to T-Plant for interim storage pending processing as Remote-Handled TRU waste.

9 Safeguards & Security

9.1 Introduction

Department of Energy (DOE) Security Orders have requirements that could affect CD-1 design and the safety aspects of the Sludge Treatment Project (STP). Documents ensuring that both the security requirements and safety requirements are satisfied for the STP(16, 32, 73-76) were reviewed to ensure that a security assessment was performed to identify security requirements and that any identified requirements were incorporated into the conceptual design for Phase 1. Specifically the following DOE-STD-1189 criteria were reviewed:

(1) The appropriate level of nuclear material safeguards and physical security are identified and documented for the STP.
(2) Threats for which a security system is required were identified and based on the Design Basis Threat (DBT), a preliminary Vulnerability Assessment (VA), or preliminary Security Assessment (SA).
(3) Preliminary nuclear material safeguards deviation or termination requirements were identified and documented.
(4) Nuclear material safeguards and security system requirements were incorporated into preliminary design documents to be employed in an effective manner to assure neutralization and protect the national security, and assure that safety requirements for any safeguards and security systems were incorporated into the conceptual design.

Nuclear material quantities and attractiveness levels in the STP material inventory are commensurate with Attractiveness Level E Category IV quantities of special nuclear material (SNM) with a bounding case of an Attractiveness Level D Category III quantity of SNM. The bounding condition would require Nuclear Material Control and Accountability (NMC&A) for sludge in the K-Basin and the STP. An approved safeguards termination(74, 75) is in place so that once the sludge transport and storage container (STSC) is loaded and ready to ship both NMC&A and physical security requirements on the sludge will be terminated. The NMC&A requirements for sludge in K-Basin are currently managed with an approved deviation(16, 76) from the DOE M 470.4-6, *Nuclear Material Control and Accountability*(77), and the bounding case for the STP Phase 1 is that the material will also have to be managed under a similar deviation. As specified in the current approved safeguards deviation, SNM content for the sludge is determined by calculation rather than direct measurement. The calculation involves multiplying a measured quantity (mass or volume of sludge) by the calculated concentration determined from characterization data. Means for measuring the mass or volume of the sludge are incorporated into the STP conceptual design(32). It is likely only a minor revision of the current deviation would be required for the bounding case, and no design changes would be necessary.

The physical protection of the bounding Category III quantity SNM involved in the STP requires processing and storage in a Limited Area (LA). A LA is currently established for the K-basin.

For this bounding case one of the following approaches for the loading area would be required: (1) establish Category III protection (typically a LA), (2) demonstrate rollup beyond Category IV is not possible, or (3) obtain a deviation for the loading area. Any of these possibilities are bounded by the current conceptual design. A Limited Security Assessment[(73)] (LSA) for the STP was performed on the conceptual design to evaluate any physical security requirements beyond the protection of the SNM. The LSA considered the consequences of a radiological sabotage event directed against the material being loaded and transported. Methodology in the LSA used bounding assumptions and concluded that based on DOE O 470.3B, *Graded Security Protection Policy*[(78)], a Security Protection Level 4 was appropriate for the STP. According to DOE O 470.3B Security Protection Level 4 facilities and activities are required to maintain minimum safeguards accountability or security operations based on existing U.S. Department of Energy directives and commonly accepted business practices (administrative controls). These requirements are bounded by the current conceptual design.

Reviewing the safeguards and security documentation verified that the safety design basis was developed in a reasonably conservative manner and that the risk associated with significant redesign due to the addition of new or different safeguards requirements is minimal. Though highly unlikely, the bounding change would be an increase on the attractiveness of the sludge material. The STP has completed a LSA which concludes that the nuclear facility safety, radiological, and shipping controls have more stringent restrictions than any current physical security and NMC&A requirements.

9.2 LOI Results

9.2.1 SS-1

Phase 1 design of the STP incorporates the physical security and control/accountability requirements as specified in the most recent and approved safeguards deviation[(16, 76)]. The NMC&A requirements for sludge in K-Basin are currently managed with an approved deviation from the DOE M 470.4-6, *Nuclear Material Control and Accountability,* and the bounding case for the STP is that the material will also have to be managed under a similar deviation. As part of this deviation, the SNM content for the sludge is determined by calculation rather than direct measurement. The calculation involves multiplying a measured quantity (mass or volume of sludge) by the calculated concentration determined from characterization data. Means for measuring the mass or volume of the sludge as it is loaded into STSC is incorporated into the Phase 1 design for the STP. The compliance-based physical security measures have been documented and incorporated into the Phase 1 design[(32)]. Nuclear facility safety, radiological, and shipping controls will have more stringent restrictions than the physical security and NMC&A requirements.

9.2.2 SS-2

A preliminary LSA[73] has been completed during the conceptual design phase, a VA was not required. A VA is completed for a facility containing Category I and II (with credible rollup) quantities of SNM. The SNM quantities for the STP project do not meet these criteria. A Security Assessment is performed for Category II, III, and IV facilities/assets. A Limited Security Assessment for the STP has been performed that determined the facilities and activities that are required to meet compliance-based standards for safeguards accountability and security operations based on existing DOE directives and commonly accepted business practices. The compliance-based physical security measures are documented and have been incorporated into the design. Nuclear facility safety, radiological, and shipping controls have more stringent restrictions and further bound the physical security and NMC&A requirements.

9.2.3 SS-3

The CSDR[32] includes a chapter on "Security Hazards and Design Implications" (chapter 5) that addresses the format and content requirements of DOE-STD-1189-2008 Appendix H.

9.2.4 SS-4

No preliminary safeguards and security deviations or variances have been completed during the conceptual design phase and factored into the PHA. It is highly likely that additional deviations or variances will not be necessary for the STP. There is one deviation[16, 76] approved for the K-basin material and an approved termination of safeguards[74, 75] on the attractiveness level D plutonium contained in the K-Basin material. The bounding quantity and category of SNM involved in the STP would require one of the following approaches: (1) establish Category III protection (typically a LA), (2) demonstrate rollup beyond Category IV is not possible: or (3) obtain a deviation for the loading area. Any of these actions are bounded by the current conceptual design. Changes to the current deviations have been anticipated and will be minor; nuclear facility safety, radiological, and shipping controls will have more stringent restrictions and bound the physical and NMC&A requirements for the worst case quantity and category of SNM.

9.3 Observations, Recommendations, and Conclusions

Conclusion: Reviewing the safeguards and security documentation verified that the safety design basis was developed in a reasonably conservative manner and that the risk associated with significant redesign due to the addition of new or different safeguards requirements is minimal. The STP has documented bounding security requirements by completing a Limited Security Assessment. The nuclear facility safety, radiological, and shipping controls have more stringent restrictions and bound any physical security and NMC&A impacts on the design.

10 Summary: Findings, Observations, Recommendations, and Conclusions,

10.1 Findings

There are no findings related to compliance with requirements as related to development of the safety basis to support the CD-1 decision.

10.2 Observations

10.2.1 General Observations

- DOE-RL and Contractor staffs were well prepared, knowledgeable, and helpful.
- The presentations were informative and provided the much needed background to put the support documentation into perspective. The tour of the scale model prototype showcased how engineering and operations activities were being merged to optimize the process.
- The Team appreciated the open exchange of information and the Project's willingness to supply as much information as possible. All the information requested was supplied quickly and in the format desired.
- The Team commends the cooperation between the CHPRC project and DOE.

10.2.2 Technical Observations

Table 10-1 Technical Observations

3. Safety Design Strategy & General Requirements	
O 3-1	Not developing a Preliminary Safety Design Report (PSDR) / Preliminary Safety Validation Report (PSVR) and waiting until DOE approves a Preliminary Documented Safety Analysis (PDSA) is not consistent with the DOE-STD-1189 safety-in-design approach. This CD-2/3 approach warrants continuous oversight from the DOE-RL Federal Integrated Project Team. In addition, as a best practice, it is suggested that the STP project schedules include appropriate DOE-RL Safety Basis Review Team in-process reviews, or formal reviews at key milestones, to assure earlier identification of any significant issues as the design and safety analysis proceeds.
4. Hazard Identification & Control Selection	
O 4-1	The current safety basis radioisotopic source term values appear to be reasonably conservative.
O 4-2	HNF-36364 requires the RADIDOSE/GXQ unmitigated dose for the 100 m Collocated Worker dose for seismic design categorizations, in addition to the DOE-STD-1189 unmitigated dose perspective. Suggest re-evaluating the need to provide both estimates, and if it's not necessary, delete it from the procedure, the CSDR, the accident analysis calculation, and other documents.
O 4-3	The Waste Treatment Plant Project recently completed revising their methodologies and key assumptions for the evaluation of Design Basis Accidents (DBAs), which was approved by DOE ORP. It is suggested that DBAs documented in 4590-PTF-Z0C-W14T-00036, *Severity Level Calculations for the Pretreatment Facility Based on Updated MAR*, that are similar to the spill, impact and over-pressurization DBAs evaluated for the STP CSDR, be reviewed to determine whether any key STP assumptions warrant revision.
O 4-4	STP methodology presented in the PRC-STD-00124 Hazard Analysis on Table 3-1 defines an offsite consequence threshold for a Low consequence as < 5 rem (50-yr Total Effective Dose). This value is not consistent with most hazard analysis methodologies previously used in the DOE Complex. It is suggested that this threshold for a Low consequence to the public be reviewed against the Hanford SARAH and earlier DOE-RL and guidance from DOE Standards to determine whether a change is warranted.
O 4-5	Based on the current CSE's, it appears that the planned transfer of sludge will meet criticality safety requirements with only a few additional controls and limits for transportation. It is likely that a criticality alarm system will not be required. The Phase 1 design is reasonably conservative with respect to criticality safety and the

	risk significant redesign is minimal.
5. Conceptual Safety Design Report / Conceptual Safety Validation Report	
O 5-1	As a Preliminary Safety Design Report (PSDR) will not be prepared for this project, it is suggested that a short discussion of the Hazards Analysis and control decision results using the format and content of the DOE-STD-1189 Appendix I PSDR/PDSA Section 3.3 "Hazard Analysis Results" be added to the CDSR. This would facilitate a better understanding of how the DOE-STD-3009 Safety Significant SSC criteria on major contributors to defense in depth and/or worker safety were applied.
6. Risks to Project Safety Decisions	
	There are no Observations for this section
7. Safety Design Integration Team – Interfaces and Integration	
	There are no Observations for this section
8. Transportation Safety	
O 8-1	As with many complex activities in the conceptual design phase, the transportation safety documents associated with the STS are still generic and target the high level activities only. Detailed information supporting the transportation safety documents have not yet been fully compiled or assimilated into a single coherent document that will become the basis for a PSSD, OTRS or F-SPA checklist. A PSSD, OTRS or F-SPA checklist is the DSA for transportation and requires the same level of detail as the hazard classification of a facility. The modifications to the STS will require major changes to the existing or new PSSD.
O 8-2	The quality, detail, and effort put into prototyping the system was excellent and well thought out. By the time the Project gets to the actual packaging operation most of the system interface issues will be resolved.
9. Safeguards & Security	
	There are no Observations for this section

10.3 Technical Recommendations

Table 10-2 Recommendations

3. Safety Design Strategy & General Requirements	
R 3-1	Revise PRC-STP-00139, *Sludge Treatment Project Engineered Container Retrieval and Transfer System*, *Safety Equipment List*, to delete the identification of the KW Basin Annex lightning protection system as Safety Significant, and add instead the fire resistance of the building structure and ventilation ductwork, and building grounding.
4. Hazard Identification & Control Selection	
R 4-1	Consider replacing the STP CSDR method for spray releases with the Waste Treatment Plant (WTP) methodology documented in 24590-WTP-RPT-ENS-10-001, *WTP Methodology for Spray Release Scenarios*.
R 4-2	Review the Waste Treatment Plant methodology for explosions in vessels documented in 24590-PTF-Z0C-W14T-00036, *Severity Level Calculations for the Pretreatment Facility Based on Updated MAR*, and determine whether any key STP assumptions warrant revisions.
R 4-3	Resolve the issue of the appropriate site boundary as soon as possible.
R 4-4	Document justifications for not selecting the Confinement Ventilation System and the Fire Suppression and Alarm Systems as Safety Significant SSCs and include them in the CSDR for DOE-RL concurrence prior to the approval of CD-1.
5. Conceptual Safety Design Report / Conceptual Safety Validation Report	
R 5-1	The basis for the Performance Category 2 determination for compliance with DOE Order O 420.1B for high winds, snow loading, ashfall loading, and flooding should be documented.
6. Risks to Project Safety Decisions	
	There are no Recommendations for this section
7. Safety Design Integration Team – Interfaces and Integration	
	There are no Recommendations for this section
8. Transportation Safety	
R 8-1	The PSSD, OTRS or F-SPA checklist is the principal transportation safety document used to determine if the package provides an equivalent degree of safety to the Type B specification. The PSSD, OTRS or F-SPA checklist should be drafted as early as possible during the project to allow for all the reviews and analysis required for a DSA.

	9. Safeguards & Security
	There are no Recommendations for this section

10.4 Conclusions

10.4.1 Safety Basis

The TIPR Team concludes that the following overall objective of the safety basis line of inquiry was met:

> **SAFETY BASIS DOCUMENTATION –** *The safety basis documentation supporting STP Phase 1 conceptual design is sufficiently conservative and bounding to be relied upon for the next phase of the project.*

The depth and quality of safety basis documentation and its integration in conceptual design is commendable. It faithfully and appropriately applies the DOE-STD-1189 approach and provides the expected level of detail necessary to support CD-1 decisions. The STP Hazards Analysis and Accident Analysis were developed per the guidance from DOE-STD-1189, including evaluating alternatives, and provide the expected level of detail necessary to support CD-1 decisions. The level of detail of the STP hazards and accident analysis to support the CSDR is perhaps more than what may be available for other projects since the process hazards and control strategy associated with STP transfers have previously been evaluated, therefore, appropriate lessons learned have been applied. The quantitative STP Accident Analysis of facility-level Design Basis Accidents provides a sound technical basis for the selection of Safety Significant SSCs at CD-1, which is supplemented by the additional Safety Significant criteria from the Hazards Analysis results. Overall, the hazards analysis, accident analysis, and control decision report establish the safety functions and functional requirements for determination of Safety Significant SSCs and potential TSR Specific Administrative Controls, and provide a solid foundation for the safety analysis and preliminary design to proceed. Issues that require resolutions to further support the safety basis for conceptual design are identified by numbered recommendations in this report; the numbered observations should also be considered by the Project. The identified risks and opportunities associated with the safety basis highlight where major impacts are possible that need to be managed.

10.4.2 Transportation Safety

The TIPR Team concludes that the following overall objective of the transportation safety line of inquiry was met:

> **TRANSPORTATION SAFETY–** *The transportation safety documentation supporting STP Phase 1 conceptual design is sufficiently conservative and bounding and applicable controls are appropriate to support transporting STP sludge to T-Plant.*

The overall approach to develop and approve transportation safety documents for the transfer of sludge to T-Plant is appropriate for the STP conceptual design. The existing procedural controls are sufficient to ensure compliance with the TSD. The conceptual design for transportation safety is based on conservative assumptions and analyses that are consistent with the Criticality Safety Evaluation Report (CSER) for the planned waste packaging. Analyses demonstrate planned shielding will achieve compliant dose rate limits established in the transportation safety basis and that expected hydrogen gas and heat generation values will not exceed the gas generation and thermal limits established in the transportation safety basis.

10.4.3 Safeguards and Security

The TIPR Team concludes that the following overall objective of the safeguards and security line of inquiry was met:

> **SAFEGUARDS & SECURITY –** *The conceptual design is consistent with safeguards and security approvals.*

The safety design basis was developed in a reasonably conservative manner, and the risk associated with significant redesign due to the addition of new or different safeguards requirements is minimal. The STP has documented bounding security requirements by completing a Limited Security Assessment. The nuclear facility safety, radiological, and shipping controls have more stringent restrictions and bound any physical security and NMC&A impacts on the design.

11 References

1. A-07-SED-017, 2007, *K Basins Sludge Treatment Process Technology Readiness Assessment Final Report*, U.S. Department of Energy, Richland Operations Office Richland, WA

2. HNF-39744, 2009, *Sludge Treatment Project Alternative Analysis Summary Report*, Rev.0, CH2M Hill Plateau Remediation Company, Richland, WA

3. HNF-41051, 2009, *Preliminary STP Container and Settler Sludge Process System Description and Material Balance*, Rev. 5, CH2M Hill Plateau Remediation Company, Richland, WA

4. HNF-SD-SNF-TI-009, 2001, *105-K Basin Material Design Basis Feed Description for Spent Nuclear Fuel Project Facilities, Vol. 2, Sludge*, Rev. 4, Fluor Hanford, Richland, WA

5. PNNL-14947, 2008, *Mechanical Properties of K Basin Sludge Constituents and Their Surrogates*, Pacific Northwest National Laboratory, Richland, WA

6. PNNL-19035, 2010, *Characterization Data Package for Containerized Sludge Samples Collected From Engineered Containers SCS-CON-240, 250, 260, 220*, Pacific Northwest National Laboratory, Richland, WA

7. Kosson, D.S., Krahn, S., Gallay, D.R., Smith, G.L., Davis, J.J., French, D.M., Etchells, A.W.III, 2009, *External Technical Review of the Hanford K Basins Sludge Treatment Project*, U.S. Department of Energy, Washington, D.C.

8. Sutter, H.G., Etchells, A., Poirier, M., Smith, G., Thomas, K., Davis, J.J., Macbeth, P., 2009, *K Basins Sludge Treatment Project Phase 1 Technology Readiness Assessment Report*, Richland Operations Office, Richland, WA

9. 2010, *Team Charter for the Technical Independent Project Review (TIPR) of the Sludge Treatment Project (STP) – Phase 1 Engineered Container / Settler Tube Retrieval and Transfer to T Plant Subproject of the 100 Area K Basin Closure Project PBS RL-012*, U.S. Department of Energy, Richland Operations Office, Richland, WA

10. DOE O 413.3A, 2006, *Program and Project Management for the Acquisition of Capital Assets*, Chg1 (2008), U.S. Department of Energy, Washington, D.C.

11. 10 CFR 830, 2001, *Nuclear Safety Management*, U.S. Department of Energy, Washington, D.C.

12. 10 CFR 835, *Occupational Radiation Protection*, U.S. Department of Energy, Washington, D.C.

13. DOE STD 1189, 2008, *Integration of Safety into the Design Process*, U.S. Department of Energy, Washington, D.C.

14. DOE/RL-2001-36, 2009, *Hanford Sitewide Transportation Safety Document*, Rev. 1C, U.S. Department of Energy, Richland Operations Office, Richland, WA

15. DOE O 460.1 A, 2008, *Radioactive Material Transportation Practices Manual*, U.S. Department of Energy Washington, D.C.

16. 10-SES-0054, 2010, *DOE approval of CHPRC-0900741 Request*, U.S. Department of Energy, Richland Operations Office, Richland, WA

17. DOE G 413.3-9, 2008, *U.S. Department of Energy Project Review Guide for Capital Asset Projects*, U.S. Department of Energy, Washington, D.C.

18. DOE-EM-SRP-2010, 2010, *Standard Review Plan (SRP) Conceptual Safety Design Review Module, 2nd Ed*, U.S. Department of Energy, Washington, D.C.

19. HNF-34374, 2010, *Sludge Treatment Project Safety Design Strategy*, Rev. 3, CH2M Hill Plateau Remediation Company, Richland, WA

20. HNF-SD-WM-SAR-062, 2009, *105-KW Basin Final Safety Analysis Report*, Rev. 14, CH2M Hill Plateau Remediation Company, Richland, WA

21. PRC-STP-00147, *Knock-Out Pot Major Modification for the 105-K West Basin, Cold Vacuum Drying Facility, and Canister Storage Building*, CH2M Hill Plateau Remediation Company, Richland, WA

22. Brockman, D.A. and J. Osso, 2009, *DOE-RL letter 10-SED-0099, May 27, 2009, to J.G. Lehew III, "Contract No. DE-AC06-08RL14788 – Knock-Out Pot Disposition Project Major Modification Determination for the 105-K West Basin, Cold Vacuum Drying Facility, and Canister Storage Building"*, Richland, WA

23. PRC-STP-00109, 2010, *Sludge Treatment Project Major Modification Determination for T-Plant*, CH2M Hill Plateau Remediation Company, Richland, WA

24. Brockman, D.A. and J. Osso, 2010, *DOE-RL letter 10-SED-0037, January 29, 2010, to J.G. Lehew III, "Contract No. DE-AC06-08RL14788 – Sludge Treatment Project Major Modification Determination for T-Plant"*, Richland, WA

25. DOE-STD-3009-94, 2006, *Preparation Guide for U.S. Department of Energy Nonreactor Nuclear Facility Documented Safety Analyses*, Change Notice No. 3, U.S. Department of Energy, Washington, D.C.

26. PRC-STP-00139, 2010, *Sludge Treatment Project Engineered Container Retrieval and Transfer System, Safety Equipment List*, Rev. 1, CH2M Hill Plateau Remediation Company, Richland, WA

27. PRC-STP-00012, 2009, *What-IF/Checklist Hazard Analysis for the Sludge Treatment Project Direct Load Alternative Conceptual Design*, CH2M Hill Plateau Remediation Company, Richland, WA

28. PRC-STP-00037, 2009, *What-IF/Checklist Hazard Analysis for the Sludge Treatment Project Small Container Sludge Retrieval Draft Conceptual Design*, Rev. 1, CH2M Hill Plateau Remediation Company, Richland, WA

29. PRC-STP-00124, 2010, *Sludge Treatment Project Engineered Container Retrieval and Transfer System Conceptual Design Hazard Analysis*, Rev. 1, CH2M Hill Plateau Remediation Company, Richland, WA

30. PRC-STP-00154, 2010, *Sludge Treatment Project Engineered Container Retrieval and Transfer System Accident Analysis*, Rev. 1, CH2M Hill Plateau Remediation Company, Richland, WA

31. PRC-STP-00161, 2010, *Sludge Treatment Project Engineered Container Retrieval and Transfer System Conceptual Design Control Decision Report*, Rev. 1, CH2M Hill Plateau Remediation Company, Richland, WA

32. PRC-STP-00156, 2010, *Sludge Treatment Project Conceptual Safety Design Report*, CH2M Hill Plateau Remediation Company, Richland, WA

33. PRC-STP-00158, 2010, *Sludge Treatment Project Engineered Container Retrieval and Transfer System Conceptual Design Hazards Categorization*, CH2M Hill Plateau Remediation Company, Richland, WA

34. DOE-HDBK-3010-94, 2000, *Airborne Release Fractions/Rates and Respirable Fractions for Nonreactor Nuclear Facilities*, Change Notice No. 1, U.S. Department of Energy, Washington, D.C.

35. HNF-8739, 2004, *Hanford Safety Analysis and Risk Assessment Handbook*, Rev. 1, Fluor Hanford, Inc., Richland, WA

36. SNF 7765, 2006, *Supporting Basis for SNF Project Technical Databook*, Rev. 3C, Fluor Hanford, Inc., Richland, WA

37. HNF-SD-SNF-TI-015, 2009, *Spent Nuclear Fuel Project Technical Databook, Vol. 2, Sludge*, Rev. 14A, CH2M Hill Plateau Remediation Company, Richland, WA

38. PRC-STP-00163, 2010, *Criticality Safety Evaluation for Engineered Container and Settler Sludge Retrieval, Transfer, Transportation and Interim Storage (Phase I)*, CH2M Hill Plateau Remediation Company, Richland, WA

39. CHPRC-00316, 2009, *CSER 09-004: Criticality Safety Evaluation Report for the 105-KW Settler Tank Retrieval System*, CH2M Hill Plateau Remediation Company, Richland, WA

40. HNF-22030, 2007, *CSER 04-026: KE and KW Sludge Collection, Transfer, and Consolidation*, Rev. 2, Fluor Hanford, Inc., Richland, WA

41. HNF-7098, 2009, *Criticality Safety Program*, Rev. 18, CH2M Hill Plateau Remediation Company, Richland, WA

42. WHC-SD-SQA-20330, 1991, *Use of k_{eff} Subcritical Limit of 0.98*, Westinghouse Hanford Company, Richland, WA

43. HNF-36364, 2008, *Seismic Design Requirements Selection Methodology for the Sludge Treatment and M-91 Solid Waste Processing Facilities Projects*, Fluor Hanford, Inc., Richland, WA

44. 24590-PTF-Z0C-W14T-00036, 2009, *Severity Level Calculations for the Pretreatment Facility Based on Updated MAR*, Bechtel National Inc., Richland, WA

45. DOE-STD-1120-2005, 2005, *Integration of Environment, Safety, and Health into Facility Disposition Activities, Volume 1 of 2: Documented Safety Analysis for Decommissioning and Environmental Restoration Projects*, U.S. Department of Energy, Washington, D.C.

46. DOE-STD-5506-2007, 2007, *Preparation of Safety Basis Documents for Transuranic (TRU) Waste Facilities*, U.S. Department of Energy, Washington, D.C.

47. Klein, K.A. and R.J. Schepens, 2003, *DOE-RL letter 03-ABD-0047, February 14 2003, to E.K. Thomson and E.S. Aromi, "Replacement of Previous Guidance Provided by RL and ORP"*, Richland, WA

48. 24590-WTP-RPT-ENS-10-001, 2010, *WTP Methodology for Spray Release Scenarios*, Bechtel National Inc., Richland, WA

49. DOE Order O 420.1B, 2005, *Facility Safety*, U.S. Department of Energy, Washington, D.C.

50. 2006, *Deliverables 8.5.4 and 8.7 of Implementation Plan for Defense Nuclear Facilities Safety Board Recommendation 2004-2 Ventilation System Evaluation Guidance for Safety-Related and Non-Safety-Related Systems*, U.S. Department of Energy, Washington, D.C.

51. Owendoff, J.M., 2009, *DOE-EM memorandum for distribution, April 15, 2009, "Implementation of DOE-STD-1189, Integration of Safety into the Design Process for Environmental Management Activities,* U.S. Department of Energy, Washington, D.C.

52. Triay, I.R., 2006, *DOE-EM memorandum for distribution, July 18, 2006, "Interim Guidance on Safety Integration on Early Phases Nuclear Facility Design,* U.S. Department of Energy, Washington, D.C.

53. PRC-STP-00164, 2010, *Sludge Treatment Project Engineered Container Retrieval and Transfer System Risk and Opportunity Assessment*, CH2M Hill Plateau Remediation Company, Richland, WA

54. PRC-STP-00171, 2010, *Sludge Treatment Project Engineered Container Retrieval and Transfer System Conceptual Design Fire Hazards Analysis*, CH2M Hill Plateau Remediation Company, Richland, WA

55. PRC-STP-00207, 2010, *Sludge Treatment Project Formal Design Review Report for the Conceptual Design of the Engineered Container Retrieval and Transfer System,* CH2M Hill Plateau Remediation Company, Richland, WA

56. DOE-STD-1104-2009, 2009, *Review and Approval of Nuclear Facility Safety Basis and Safety Design Basis Documents*, U.S Department of Energy, Washington, D.C.

57. PRC-PRO-EN-097, 2009, *Engineering Design and Evaluation (Natural Phenomena Hazard),* Rev. 0 Chg. 2, CH2M Hill Plateau Remediation Company, Richland, WA

58. DOE-STD-1020-2002, 2002, *Natural Phenomena Hazards Design and Evaluation Criteria for Department of Energy Facilities*, U.S. Department of Energy, Washington, D.C.

59. DOE-STD-1021-93, 1996, *Natural Phenomena Hazards Performance Categorization Guidelines for Structures, Systems, and Components*, Change Notice No. 1, U.S. Department of Energy, Washington, D.C.

60. PRC-STP-00166, 2010, *CD-1 Report for the Sludge Treatment Project Engineered Container Retrieval and Transfer System*, CH2M Hill Plateau Remediation Company, Richland, WA

61. HNF-35063, 2010, *Sludge Treatment Project Safety Design Integration Team Charter*, Rev. 6, CH2M Hill Plateau Remediation Company, Richland, WA

62. PRC-STP-00111, 2009, *STP Contractor Integrated Project Team Charter*, CH2M Hill Plateau Remediation Company, Richland, WA

63. 2008, *Sludge Treatment Project, Federal Integrated Project Team Charter*, U.S. Department of Energy, Richland Operations Office, Richland, WA

64. 2010, *Sludge Treatment Project, EC/ST Disposition Sub-project Phase I, Critical Decision – 1 Readiness Plan*, U.S. Department of Energy, Richland Operations Office, Richland, WA

65. PRC-RD-TP-7900, 2009, *Transportation and Packaging Program Requirements*, Rev. 1 Chg. 2, CH2M Hill Plateau Remediation Company, Richland, WA

66. PRC-PRO-TP-15665, 2009, *Transportation Safety Basis Documents*, Rev. 0 Chg. 2, CH2M Hill Plateau Remediation Company, Richland, WA

67. PRC-STP-00200, 2010, *Sludge Treatment Project Transportation Safety Basis Documentation Plan*, Rev. 0, CH2M Hill Plateau Remediation Company, Richland, WA

68. SNF-10823, 2003, *Sludge Transport System*, Rev. 1E, Fluor Hanford Inc., Richland, WA

69. PRC-STP-00213, 2010, *Determination if a New Transportation Safety Document is Necessary for the Transport of the K-East Engineered Container Sludge*, Rev. 0, CH2M Hill Plateau Remediation Company, Richland, WA

70. Macbeth, P.J., 2010, *email RE: Criteria Document for STP Shipment – Final Version*, Richland, WA

71. PRC-STP-00102, 2009, *Finalized Revision to Preliminary Shielding Calculations for Direct Loading of K-Basins Sludges*, Rev. 1, CH2M Hill Plateau Remediation Company, Richland, WA

72. PRC-STP-00220, 2010, *Sludge Treatment Project Engineered Container Retrieval and Transfer System - Thermal and Gas Analyses for STSC Loaded with KW Engineered Container Sludge*, Rev. 0, CH2M Hill Plateau Remediation Company, Richland, WA

73. SAS-SA2009-003, 2010, *Limited Security Assessment for the Sludge Treatment Project*, Mission Support Alliance, Richland, WA

74. 06-SES-0192, 2006, *DOE approval of FH-0500438*, U.S. Department of Energy Richland Operations Office, Richland, WA

75. FH-0500438, 2006, *Request for Termination of Safeguards on Attractiveness Level "D" Plutonium Contained in K-West Basin Sludge*, Fluor Hanford Inc., Richland, WA

76. CHPRC-0900741, 2009, *Request for Variance from U.S. Department of Energy Order Requiring Nuclear Material Measurement and Measurement Control Programs When Packaging K East Basin Sludge and K West Basin Sludge*, CH2M Hill Plateau Remediation Company, Richland, WA

77. DOE M 470.4-6, 2006, *Nuclear Material Control and Accountability*, Chg. 1, U.S. Department of Energy, Washington, D.C.

78. DOE O 470.3B, 2008, *Graded Security Protection Policy*, U.S. Department of Energy, Washington, D.C.

Appendix A Line of Inquiry Tables

Appendix A summarizes the responses to each of the Line of Inquiries.

SAFETY BASIS DOCUMENTATION – *The safety basis documentation supporting STP Phase 1 conceptual design is sufficiently conservative and bounding to be relied upon for the next phase of the project.*

Table A-1 Safety Design Strategy & General Requirements (SD)			
ID #	**Performance Objectives and Criteria[1]**	Met?	**Comments, Basis and Documentation**
SD	***Safety Design Strategy (SDS) & General Requirements***		
SD-1	**Does the SDS include the key elements required by DOE-STD-1189-2008?**	Yes	Addressed in *Sludge Treatment Project Safety Design Strategy*, HNF-34374, Rev. 3
	1. Does the SDS describe or define the Safety-in-Design approach and philosophies?	Yes	Addressed in section 3.1, "Safety Guidance and Requirements"
	2. Does the SDS define the criteria or approach to safety functional classification, including evaluation guidelines for both radiological and toxicological hazards and for public and worker protection?	Yes	Addressed in section 3.1.2, "Safety Functional Classification"
	3. Does the SDS identify the safety criteria to be applied to the project (commitment to DOE G 420.1-1; DOE O 420.1B, etc)?	Yes	Addressed in section 3.1.3, "Safety Design Criteria"
	4. Does the SDS provide a logical discussion of the major hazards involved in the project and the possible consequences those hazards may pose?	Yes	Addressed in section 2.5, "Major Hazards"
	5. Is the hazard identification based on the initial or assumed hazard inventories?	Yes	Addressed in section 2.5.1, "Container and Settler Sludge Major Hazards". Based upon historic characterization, process analysis, and experience with management of the sludge.
	6. Does the SDS discuss key safety decisions that potentially result in significant cost or have resulted in costly rework in past projects?	Yes	Addressed in section 3.3, "Key Safety Decisions"
	7. Are the following topics explicitly addressed in the SDS and the strategy justified consistent with the hazard categorization and any associated consequence estimates	--	
	• Seismic and other natural phenomena	Yes	Addressed in section 3.3.1, "Container and Settler Tank Sludge Key Safety Decisions"

Table A-1 Safety Design Strategy & General Requirements (SD)			
ID #	**Performance Objectives and Criteria[1]**	Met?	**Comments, Basis and Documentation**
SD	***Safety Design Strategy (SDS) & General Requirements***		
	• Confinement strategy	Yes	Addressed in section 3.3.1.1, "Confinement Strategy"
	• Fire prevention and mitigation strategy	Yes	Addressed in section 3.3.1.2, "Fire Mitigation Strategy"
	• Anticipated safety functions?	Yes	Addressed in section 3.3.1.3, "Anticipated Safety Structures, Systems, and Components" and Table 3-7 summary of safety functions
	8. Does the SDS identify the 10 CFR 830 Subpart B safe harbor methodologies that will ultimately authorize operations (e.g., DOE-STD-3009, Transportation Safety Document/DOE Order 460, etc.) and describe the interfaces with all affected existing facilities' safety basis documents?	Yes	DOE-STD-3009 safe harbor for operations is identified in section 5.0, "Safety Analysis Approach and Plan". STP Phase I interfaces with K-Basins and T-Plant safety bases and the Transportation Safety Document are addressed in Section 5.1.1, "Activities and Deliverables".
	9. Are the assumptions supporting the DOE-STD-1189 major modification decision for the storage of sludge at T Plant to be authorized via the Unreviewed Safety Question Determination or safety basis amendment processes reasonable and is the documentation supporting the analysis adequate to support the decision?	Yes	Addressed in PRC-STP-00109, *Sludge Treatment Plant Major Modification Determination for T-Plant*, using the evaluation criteria provided in Table 8-1 of DOE-STD-1189. A *Safety Assessment for the Storage of K Basins Sludge at T Plant* (HNF-6964, Rev. 1) was performed to support this determination. DOE RL letter 10-SED-0037 concurred that STSC storage is not a major modification for T-Plant but will require revisions due to the need for new or revised Technical Safety Requirements (TSRs) and safety SSCs. The determination was reviewed and concluded to be adequate to support the decision.
	10. Are the assumptions supporting the DOE-STD-1189 major modification decision for those proposed activities related to EC/ST Phase 1 to be authorized at the KW Basin or the planned Knockout Pot activities at KW Basin, Cold Vacuum Drying Facility (CVDF), and the Canister Storage Building (CSB) via the Unreviewed Safety Question Determination or safety basis amendment processes reasonable and is the documentation supporting the analysis adequate to support the decision?	Yes	The EC/ST Phase 1 activities involving sludge retrieval from Engineered Containers and Settler Tubes at the KW Basin were recognized to be a major modification and are following the DOE-STD-1189 approach for safety integration in design. Knock-Out Pot (KOP) retrieval from the KW Basin using Multi-Canister Overpacks is being evaluated per the Unreviewed Safety Question Determination process against the K-Basin Final Safety Analysis Report (FSAR), HNF-SD-WM-SAR-062 Rev. 14. The major modification determination for

Table A-1 Safety Design Strategy & General Requirements (SD)			
ID #	**Performance Objectives and Criteria[1]**	Met?	**Comments, Basis and Documentation**
SD	***Safety Design Strategy (SDS) & General Requirements***		
			drying the material at the CVDF and storing at the CSB are documented in PRC-STP-00147, *Knock Out Pot Major Modification for the 105-K West Basin, Cold Vacuum Drying Facility, and Canister Storage Building*, used the evaluation criteria provided in Table 8-1 of DOE-STD-1189. DOE RL letter 10-SED-0099 concurred that these activities are not major modifications against the current approved safety basis documents, but will require revisions due to the need for new or revised TSRs and safety SSCs. The determination was reviewed and concluded to be adequate to support the decision.
	• Are the proposed activities and physical modifications associated with the EC/ST Phase 1 clearly identified for coverage under the Conceptual Safety Design Report (CSDR) vs. those activities in the KW Basin that are being authorized via the K-Basin Final Safety Analysis Report, with appropriate consideration of the interfaces in applicable safety basis documents?	Yes	Addressed in SDS sections 2.4.1 "Facilities", 2.4.2 "Processes", 5.1.1 EC/ST "Activities and Deliverables", and 5.2.1 KOP "Activities and Deliverables"
	11. Were the appropriate oversight organizations (e.g., DOE Environmental Management; DOE Health, Safety & Security; DOE Chief of Nuclear Safety; Defense Nuclear Facility Safety Board) provided the SDS and were their comments or concerns, if any, adequately resolved or have a disposition path formally included in project planning?	Yes	DOE EM and the Office of Chief of Nuclear Safety have been informed of the Phase I scope and SDS, and no issues have been identified to date that require resolution. The DNFSB has also been provided the SDS and other project information including the draft CD-1 package submittal, and no issues have been identified to date that require resolution. It is possible that any of these external groups may identify comments on the CD-1 submittal that includes the SDS, CSDR, and other supporting information.
SD-2	**Does the SDS meet the format and guidance criteria in DOE-STD-1189-2008, Appendix E?**	Yes	See responses below
	1. Does the SDS include a "Purpose" section that addresses the format and content requirements of DOE-STD-1189-2008 Appendix E?	Yes	Addressed in SDS section 1.0 "Purpose"

Table A-1 Safety Design Strategy & General Requirements (SD)			
ID #	**Performance Objectives and Criteria[1]**	Met?	**Comments, Basis and Documentation**
SD	***Safety Design Strategy (SDS) & General Requirements***		
	2. Does the SDS include a "Description of Project/Modification" section that addresses the format and content requirements of DOE-STD-1189-2008 Appendix E?	Yes	Addressed in SDS section 2.0 "Description of Project"
	3. Does the SDS include a "Safety Strategy" section that addresses the format and content requirements of DOE-STD-1189-2008 Appendix E?	Yes	Addressed in SDS section 3.0 "Safety Strategy"
	4. Does the SDS include a "Risks to Project Safety Decisions" section that addresses the format and content requirements of DOE-STD- 1189-2008 Appendix E?	Yes	Addressed in SDS section 4.0 "Risk to Project Safety Decisions"
	5. Does the SDS include a "Safety Analysis Approach and Plan" section that addresses the format and content requirements of DOE-STD-1189-2008 Appendix E?	Yes	Addressed in SDS section 5.0"Safety Analysis Approach and Plan"
	6. Does the SDS include a "SDIT- Interfaces and Integration" section that addresses the format and content requirements of DOE-STD- 1189-2008 Appendix E?	Yes	Addressed in SDS section 6.0 "Safety-in-Design Integration Team – Interfaces and Integration"
SD-3	**Did the hazard analysis activities in the conceptual design phase address the key elements of DOE-STD-1189-2008 section 3.2?**	Yes	See responses below
	1. When design requirements are established, are alternatives evaluated to establish a process approach that includes facility and equipment arrangements?	Yes	Addressed in CD-1 Report, PRC-STP-00166, section 2.4 "Project Trade Study".

Table A-1 Safety Design Strategy & General Requirements (SD)			
ID #	**Performance Objectives and Criteria[1]**	Met?	**Comments, Basis and Documentation**
SD	***Safety Design Strategy (SDS) & General Requirements***		
	2. Have DOE expectations for Safety-in-Design and the Safety Design Guiding Principles and key concepts been applied to ensure that the design requirements and the selection of the preferred processing and facility arrangement alternatives were performed in a way that will result in a safe design?	Yes	Hazards analysis, accident analysis, and control decisions were performed for the draft conceptual designs of the two alternatives, i.e., Direct Hydraulic Loading and Underwater Loading into Small Containers. These analyses are documented in PRC-STP-00012 *What-IF/Checklist Hazard Analysis for the Sludge Treatment Project Direct Load Alternative Conceptual Design*, PRC-STP-00037, Rev. 1, *What-IF/Checklist Hazard Analysis for the Sludge Treatment Project Small Container Sludge Retrieval Draft Conceptual Design*, PRC-STP-00043 *Accident Analysis for Sludge Treatment Project Draft Conceptual Designs* [note: this document was not reviewed by the TIPR team; see PRC-STP-00154 discussed in next paragraph for the Direct Load Alternative for accident analysis approach used for the accident analysis of the two alternatives]. They were performed using the Safety Design Guiding Principles and key concepts provided in DOE-STD-1189. For the preferred Direct Hydraulic Load alternative, PRC-STP-00124 Rev. 1 *Sludge Treatment Project Engineered Container Retrieval and Transfer System Hazard Analysis*, PRC-STP-00154 Rev. 1, *Sludge Treatment Project Engineered Container Retrieval and Transfer System Accident Analysis*, and PRC-STP-00161 Rev. 1 *Sludge Treatment Project Engineered Container Retrieval and Transfer System Conceptual Design Control Decision Report*, were prepared and used to develop the PRC-STP-00156 *Sludge Treatment Project Conceptual Safety Design Report*.

Table A-1 Safety Design Strategy & General Requirements (SD)			
ID #	**Performance Objectives and Criteria**[1]	Met?	**Comments, Basis and Documentation**
SD	***Safety Design Strategy (SDS) & General Requirements***		
	3. Has a safety analyst been involved as part of the evaluation for each of the various alternatives?	Yes	Safety analysts participated in the hazard analysis and control decision meetings for the draft conceptual designs of the Direct Hydraulic Loading alternative and the Underwater Loading into Small Containers alternative. The STP Nuclear Safety Lead was a voting panel member in the value engineering study PRC-STP-00089 *Sludge Treatment Project Value Engineering for Sludge Loading Alternative Selection*, that recommended the Direct Hydraulic Loading alternative. See also HNF-39744 *Sludge Treatment Project Alternatives Analysis Summary Report* as referenced in the CD-1 report section 2.4.1"Alternatives Analysis"
	4. Have the Integrated Project Team (IPT) and the Safety Design Integration Team (SDIT) ensured that the relative hazards, as well as the costs and uncertainties associated with the hazard controls that may be required to address these hazards are considered for each alternative?	Yes	For the alternative selections, the hazards and their controls and control costs were considered in making the selections. The alternative evaluations were reviewed by the SDIT and subsequently by the IPT. For the control selections as part of the control decision for the ECRTS, the SDIT participated in the alternative control evaluations and selections, and the IPT has reviewed the control selections as part of the conceptual design review.
	5. Has the safety work completed for the conceptual design phase accomplished the following:	--	
	• Document and establish the preliminary inventory of hazardous materials	Yes	Hazardous material inventories are documented in the CSDR section 3.1 “Hazardous Material Inventories”, based on previous inventory characterization at the K-Basins and development of the current FSAR/TSRs.
	• Establish and document the preliminary hazard categorization of the facility	Yes	PRC-STP-00158 *Sludge Treatment Project Engineered Container Retrieval and Transfer System Conceptual Design Hazards Categorization* and CSDR section 3.2 "Comparison of Inventories to Threshold Quantities" provide the hazard categorization of the facility as Hazard Category 2.

Table A-1 Safety Design Strategy & General Requirements (SD)			
ID #	**Performance Objectives and Criteria[1]**	Met?	**Comments, Basis and Documentation**
SD	***Safety Design Strategy (SDS) & General Requirements***		
	• Identify and analyze primary facility hazards and facility-level design basis accidents	Yes	Facility hazards are identified and evaluated in PRC-STP-00124, Rev. 1, *Sludge Treatment Project Engineered Container Retrieval and Transfer System Conceptual Hazard Analysis*. Facility-level design basis accidents are identified and analyzed in PRC-STP-00154, Rev. 1, *Sludge Treatment Project Engineered Container Retrieval and Transfer System Accident Analysis*, and in the CSDR Chapter 4.0, "Design Basis Accidents".
	• Provide an initial determination, based on the Preliminary Hazards Analysis (PHA), of safety class and safety significant Structures, Systems, and Components (SSCs)?	Yes	The initial determination of safety SSCs is provided in PRC-STP-00161, Rev. 1, *Sludge Treatment Project Engineered Container Retrieval and Transfer System Conceptual Design Control Decision Report*, and in the CSDR section 4.4, "Preliminary Selection and Classification of Safety Structures, Systems, and Components". Only Safety Significant SSCs are identified since no Safety Class SSCs are required.
	6. Has a Safety-in-Design and Opportunity Assessment been used to evaluate the overall safety design basis risks and opportunities associated with the project?	Yes	A risk and opportunity assessment was performed and documented in PRC-STP-00164 *Sludge Treatment Project Engineered Container Retrieval and Transfer System Conceptual Design Risk and Opportunity Assessment*. This assessment has been reflected in the CD-1 report, the CSDR, and in Revision 3 to the SDS.

Table A-1 Safety Design Strategy & General Requirements (SD)			
ID #	**Performance Objectives and Criteria[1]**	Met?	**Comments, Basis and Documentation**
SD	***Safety Design Strategy (SDS) & General Requirements***		
	7. Have the following major activities taken place during the conceptual design phase:	--	
	• The requirements analysis from the pre-conceptual phase has been further developed to include safety functions and SSC requirements and is documented in the Conceptual Design Report (CDR)	Yes	Addressed in PRC-STP-00139 Rev 1 *Sludge Treatment Project Engineered Container Retrieval and Transfer System, Safety Equipment List*, which is included as Appendix N to the CD-1 Report, PRC-STP-00166. Note: The KW Basin Annex lightning protection system is incorrectly listed on Tables 3 and 4 as Safety Significant, instead of the fire resistance of the building structure and ventilation ductwork, and building grounding. This was identified to the project team during this review.
	• Alternative design concepts have been analyzed and a preferred alternative has been selected	Yes	Two alternative design concepts, i.e., Direct Hydraulic Loading and Underwater Loading into Small Containers, were analyzed. See response to SD-3 # 2 above.
	• A SDS has been developed that meets the requirements listed above	Yes	STP SDS HNF-34374 revision 3 submitted for approval with CD-1 deliverables. See response to SD-1 above.
	• A preliminary hazards analysis (PHA) has been performed to provide the basis for facility preliminary hazard categorization	Yes	The PHA for the preferred Direct Hydraulic Load alternative is documented in PRC-STP-00124 Rev. 1 *Sludge Treatment Project Engineered Container Retrieval and Transfer System Hazard Analysis*. The preliminary hazard categorization is documented in PRC-STP-00158 *Sludge Treatment Project Engineered Container Retrieval and Transfer System Conceptual Design Hazards Categorization*, and is based on the inventory of radioactive materials and the methodology of DOE-STD-1027. The preliminary hazard categorization is summarized in the CSDR section 3.2, "Comparison of Inventories to Threshold Quantities".
	• A preliminary Fire Hazards Analysis (PFHA) has been performed that identifies and assesses fire risk and defines levels of Safety-in-Design	Yes	Addressed in PRC-STP-00171 *Sludge Treatment Project Engineered Container Retrieval and Transfer System Conceptual Design Fire Hazards Analysis*.
	Does the STP PFHA address the Maximum	N/A	The International Building Code establishes

Table A-1 Safety Design Strategy & General Requirements (SD)			
ID #	**Performance Objectives and Criteria[1]**	Met?	**Comments, Basis and Documentation**
SD	***Safety Design Strategy (SDS) & General Requirements***		
	Allowable Quantity (MAQ) per Control Area for hazardous materials as prescribed by Washington Administrative Code (WAC) 173-303 and the International Fire Code		occupancy classification for High-hazard group H, based primarily on quantities for hazardous materials defined and presented in Table 307.1(1) and Table 307.1(2). These tables address flammable liquids, combustible liquids, as well as categories of materials posing a health hazard including corrosives, highly toxic materials, and toxic materials. The International Fire Code Tables 2703.1.1(1) and 2703.1.1(2) reproduce the information provided in IBC Tables 307.1(1) and 307.1(2) for the purpose of occupancy classification, and Chapter 27 of the IFC provides design requirements for H, S, and M occupancy facilities for which the MAQ per control area is exceeded. Radiological materials were previously addressed in the UBC (1997 edition) via a footnote reference in Table 3E to the Uniform Fire Code, notably section 8002.2.2 and Table 8001.15. This section and table included quantities of alpha, beta, and gamma emitters as a health hazard. These tables were revised with the conversion to the International Fire Code. The IFC and IBC MAQ tables no longer include references to radiological materials. The terms *toxic* and *highly toxic* are defined by the code using the term *chemical*. In 2001, Fluor Hanford provided DOE RL and the Washington State Department of Ecology with detailed waste characterization information on K Basins sludge (FH-0100738). This characterization, performed in accordance with WAC 173-303, addresses the waste characteristics of ignitability, corrosivity, reactivity, toxicity, and persistence in the environment. The conclusion of the waste characterization is that none of these hazardous characteristics are exhibited by the K Basins sludge. DOE RL concurrence with this determination was provided in 01-SFO-051.

Table A-1 Safety Design Strategy & General Requirements (SD)			
ID #	**Performance Objectives and Criteria[1]**	Met?	**Comments, Basis and Documentation**
SD	***Safety Design Strategy (SDS) & General Requirements***		
			The *Sludge Treatment Project Engineered Container Retrieval and Transfer System Conceptual Design Fire Hazards Analysis,* PRC-STP-00171, classifies the Modified KW Basin Annex as an F-1 Factory Industrial, Moderate Hazard occupancy. This classification is based on the conclusion that the sludge does not meet the definition of any material posing a physical or health hazard in accordance with the definitions provided in Section 307 of the IBC, and is not a hazardous waste as defined by WAC 173-303. Hazardous material MAQs are not specifically addressed in the FHA, because the K Basins sludge does not meet the definition of any hazardous material having an MAQ defined by the IBC or IFC.
	Are the quantities of ignitable and reactive waste developed using a conservative method?	N/A	The 2001 waste designation, which concludes that the K Basins sludge is not ignitable or reactive, is based on laboratory testing as documented in Attachment 1 of FH-0100738. Because the official waste designation for K Basins sludge concludes that the material is not ignitable or reactive, no "quantities of ignitable and reactive waste" were calculated.

Table A-1 Safety Design Strategy & General Requirements (SD)			
ID #	**Performance Objectives and Criteria[1]**	Met?	**Comments, Basis and Documentation**
SD	***Safety Design Strategy (SDS) & General Requirements***		
	Does storing the sludge at T Plant comply with WAC 173-303 MAQ limits?	N/A	As previously stated, the 2001 waste designation for K Basins sludge concludes that the material is not defined as ignitable, corrosive, reactive, toxic, or persistent in the environment. The CD-1 scope of work did not include design related to storage of K Basins sludge at T Plant. The CD-1 scope of work also did not include revision of the *Solid Waste Operations Complex Fire Hazards Analysis*. However, based on the conclusion that the K Basins sludge does not meet the definition of any material posing a physical or health hazard in accordance with the definitions provided in Section 307 of the IBC, it can also be concluded that MAQ limits are not exceeded by the proposed storage of K Basins sludge at T Plant.
	• A preliminary criticality safety evaluation(s) has been performed that identifies and evaluates appropriate base-case scenarios supporting credible normal and abnormal operating conditions developed as required by DOE O420.1B and DOE-STD-3007-2007, (*Guidelines for Preparing Criticality Safety Evaluations at Department of Energy Non-Reactor Nuclear Facilities*).	Yes	PRC-STP-00163, January 2010, *Criticality Safety Evaluation for Engineered Container and Settler Sludge Retrieval, Transfer, Transportation and Interim Storage (Phase I)*, was prepared. It identifies previous CSERs to select preliminary Safety Significant controls and to support the expectation that a criticality accident alarm system will not be required.
	• A facility-level Design Basis Accident (DBA) analysis has been performed to identify the major facility safety functions needed	Yes	Facility-level design basis accidents are identified and analyzed in PRC-STP-00154, Rev. 1, *Sludge Treatment Project Engineered Container Retrieval and Transfer System Accident Analysis*, and in the CSDR Chapter 4.0, “Design Basis Accidents".
	• The SSCs and the safety classifications are proposed for the major safety functions	Yes	The safety SSCs and the safety classifications proposed for the major facility safety functions are provided in the Control Decision Report PRC-STP-00161, and in the CSDR section 4.4, “Preliminary Selection and Classification of Safety Structures, Systems, and Components".

Table A-1 Safety Design Strategy & General Requirements (SD)			
ID #	**Performance Objectives and Criteria[1]**	Met?	**Comments, Basis and Documentation**
SD	***Safety Design Strategy (SDS) & General Requirements***		
	• The initial Safety-in-Design Risk and Opportunities Assessment has been developed	Yes	Addressed in PRC-STP-00164 *Sludge Treatment Project Engineered Container Retrieval and Transfer System Conceptual Design Risk and Opportunity Assessment*.
	• The CDR has been developed to document the final conceptual design	Yes	The CD-1 report is contained within the package (PRC-STP-00166) submitted by by letter CHPRC-1000122, dated February 22, 2010, from John G. Lehew, III, CH2M Hill Plateau Remediation Company, to Jenise C. Connerly, DOE-RL.
	• The CSDR has been developed to document the bases for the safety design aspects of the facility	Yes	The CSDR is document PRC-STP-00156 *Sludge Treatment Project Conceptual Safety Design Report*. See responses to CRs below.
	• Required technical studies necessary to resolve risks and opportunities have been identified	Yes	Studies are identified in PRC-STP-00164 *Sludge Treatment Project Engineered Container Retrieval and Transfer System Conceptual Design Risk and Opportunity Assessment*, and summarized in CSDR section 7.1 "Planned Studies or Analyses".
	• The initial baseline range estimates have been identified?	Yes	Addressed in CD-1 report PRC-STP-00166 Chapter 6 "Cost Estimate".

[1]*The site should provide the technical bases and assumptions that support the answers provided to each Line of Inquiry. If possible, the review teams should independently verify the technical bases and assumptions.*

SAFETY BASIS DOCUMENTATION – *The safety basis documentation supporting STP Phase 1 conceptual design is sufficiently conservative and bounding to be relied upon for the next phase of the project.*

Table A-2 Hazard Identification & Control Selection (HI)			
ID #	**Performance Objectives and Criteria**[1]	Met?	**Comments, Basis and Documentation**
HI	***Hazard Identification & Control Selection***		
HI-1	**Did the hazard analysis activities in the conceptual design phase address the key elements of DOE-STD-1189-2008 section 4.2? When design requirements are established, are alternatives evaluated to establish a process approach that includes facility and equipment arrangements?**	Yes	See responses below
	1. When design requirements are established, are alternatives evaluated to establish a process approach that includes facility and equipment arrangements?	Yes	See response to SD-3 # 2.
	2. Do the hazards identified in the PHA address all of the operations (including startup and shutdown) for both normal operations and upset conditions?	Yes	The hazard analysis is documented in PRC-STP-00124. The hazard analysis systematically addressed the 8 operating modes described in HNF-41051, *Preliminary STP Container and Settler Sludge Process System Description and Material Balance*. It included both normal operations and upset conditions. Example of upset conditions include STSC overfill recovery and automatic line flush on loss of power.
	- Have the appropriate facility hazards been identified and were the risks from these hazards properly analyzed in the CSDR?	Yes	Hazards are identified in Hazard Analysis PRC-STP-00124. The risks from the hazards are analyzed in the CSDR in accordance with the CSDR format and content requirements provided in Appendix H of DOE-STD-1189.
	3. Are conservative release estimates developed in the analytical calculations, and conservative radiological and toxicological consequence analyses performed consistent with DOE-STD-1189 appendices?	Yes	Facility-level design basis accidents are identified and analyzed in the Accident Analysis PRC-STP-00154 and in the CSDR Chapter 4.0, "Design Basis Accidents". The analytical methodology and assumptions, described in these documents, are conservative and consistent with DOE-STD-3009 and DOE-HDBK-3010 *Airborne Release Fractions/Rates and Respirable Fractions for Nonreactor Nuclear Facilities*.

Table A-2 Hazard Identification & Control Selection (HI)			
ID #	**Performance Objectives and Criteria[1]**	Met?	**Comments, Basis and Documentation**
HI	***Hazard Identification & Control Selection***		
	- Is the hazard and accident analysis methodology consistent with nuclear safety basis approaches in the DOE Complex, as modified by DOE-STD-1189 guidance or the *Hanford Safety Analysis and Risk Assessment Handbook* methods, as appropriate?	Yes	The hazard and accident analysis methodology was developed using the guidance in SARAH (HNF-8739**,** *Hanford Safety Analysis and Risk Assessment Handbook) and* DOE-STD-1189. SARAH guidance is consistent with DOE-STD-3009. The release source terms are consistent with DOE-HDBK-3010 for all DBAs except for the spray release modeling based on the Hanford SPRAY code methodology and SARAH guidance.
	4. Were the safety related SSC properly classified using the Exposure Guideline values as directed by DOE-STD-1027? [DNFSB 2004-2]	Yes	The safety related SSCs were classified using the guidance from DOE-STD-1189 Appendices A through D, and the DOE-STD-3009 Safety Class and Safety Significant criteria. [note: the DOE-STD-1027 reference in the LOI is incorrect.]
	5. Do hazards analyses support the preliminary identification of the required safety functions as well as the preliminary set of SSCs?	Yes	Safety functions and the associated preliminary set of safety SSCs are documented in the Control Decision Report PRC-STP-00161. The safety functions were derived from the hazard and accident analyses.
	6. Has the hazards analysis been used to support preliminary identification of defense-in-depth or important to safety SSCs to the design staff as appropriate?	Yes	The Hazard Analysis and Control Decision Report identify candidate controls for each hazardous condition. Candidate controls not selected as safety-significant provide a defense-in-depth function. Design staff participated in both the hazard analysis and control decision meetings as indicated in the attendance rosters appended to Hazard Analysis PRC-STP-00124, and Control Decision Report PRC-STP-00161.

Table A-2 Hazard Identification & Control Selection (HI)			
ID #	**Performance Objectives and Criteria**[1]	Met?	**Comments, Basis and Documentation**
HI	***Hazard Identification & Control Selection***		
HI-2	**Are controls strategies for DBAs clearly identified in the hazard analysis? Does the DBA control strategy include required safety functions and classifications?**	Yes	See responses below, based on both the hazards and accident analyses and the PRC-STP-00161 Control Decision Report.
	1. Are safety decisions consistent with prevention / mitigation preferences established in the approved SDS?	Yes	The SDS specifies application of the prevention/mitigation preferences of DOE-STD-1189, "Safety Design Guiding Principles," Item # 2. The same order of preference is identified in PRC-STP-00161, section 4.1, "Control Decision Methodology." The CSDR section 4.4 "Preliminary Selection and Classification of Safety Structures, Systems, and Components" presents the control decisions and discusses the controls in the context of the order of preference (e.g., primary containment provides an engineered, preventive control; secondary containment provides a mitigative engineered controls located close to the hazard, etc.).
	2. Does the DBA control strategy include the SSCs required to perform the identified safety functions?	Yes	SSCs and Specific Administrative Controls have been identified to perform the identified safety functions as shown in Tables 4-19 through 4-26 of the CSDR.
	3. Does the DBA control strategy include natural phenomena hazard (NPH) performance categories (non seismic NPH) and seismic design bases for major SSCs?	Yes	As discussed in CSDR section 4.4.4, "Natural Phenomenon Hazards," the DBA control strategy for non-seismic NPH specifies Performance Category 2 for wind and snow/ashfall loadings. For major SSCs, the control strategy specifies a seismic design basis of SDC-3. In accordance with the guidance in DOE-STD-1189, Limit State D has been conservatively applied.

Table A-2 Hazard Identification & Control Selection (HI)			
ID #	**Performance Objectives and Criteria[1]**	Met?	**Comments, Basis and Documentation**
HI	***Hazard Identification & Control Selection***		
	4. Was the hazards analysis process used to arrive at the identified controls based on sound safety principles?	Yes	Controls were identified through a hazards analysis, accident analysis, and control decision process. The hazards analysis (PRC-STP-00124) used a What-If/Checklist methodology to systematically identify and evaluate hazards posed by the process, NPH, and external events. The accident analysis (PRC-STP-00154) quantified the consequences of DBAs using conservative parameters for material-at-risk, airborne release fraction/respirable fraction, dose conversion factors, and dispersion estimates to receptors. Based on the results from the accident analysis and applying the evaluation criteria in Appendices A, B, and C of DOE-STD-1189, controls were selected (PRC-STP-00161) consistent with the control selection order of preference provided in DOE-STD-1189.
	5. Were the hazards analysis process and the criteria for selection of safety SSCs appropriately conservative?	Yes	The hazards analysis was conservatively performed without taking credit for safeguards already incorporated in the design. The accident analysis calculated the unmitigated consequences of the DBAs using conservative parameters. The criteria for the selection of safety SSCs was taken from Appendices A, B, and C of DOE-STD-1189.
HI-3	**Were the necessary inputs for the completion of the PHA provided and used in the PHA process including:**	--	
	• Facility site or location selection	Yes	The facility site plan provided to and used in the hazards analysis is shown in Figures A-10 and F-10 of the Hazards Analysis PRC-STP-00124.
	• General arrangement drawings	Yes	The general arrangement drawings provided to and used in the hazard analysis are shown in Figures A-11 through A-16, A-19, A-20, F-11, and F-12 of the Hazards Analysis PRC-STP-00124.
	• Material-at-Risk (MAR) estimates or assumptions and material flow balances	Yes	The material-at-risk was developed using the guidance in SARAH. SARAH guidance is consistent with DOE-STD-3009 and DOE-STD-1189 to establish a "reasonably conservative" bounding estimate for conceptual design.

Table A-2 Hazard Identification & Control Selection (HI)			
ID #	**Performance Objectives and Criteria[1]**	Met?	**Comments, Basis and Documentation**
HI	***Hazard Identification & Control Selection***		
	- Were conservative MAR values used to determine the safety classification of the operations?	Yes	The safety classification of the SSCs used material-at-risk developed using the guidance in SARAH that is the basis for the current FSAR/TSRs, and is consistent with the guidance from DOE-STD-1189.
	• Sizing of major process system containers, tanks, piping and similar items	Yes	The sizing of major process equipment was provided by HNF-41051 and P&IDs. The P&IDs are included in Appendices A and F of the Hazards Analysis PRC-STP-00124.
	• Process block flow diagrams or equivalent documentation of the required major process flow steps and their sequence	Yes	Process flow diagrams and P&IDs were provided to and used in the hazard analysis and are shown in Appendices A and F of the Hazards Analysis PRC-STP-00124.
	• Preliminary one-line diagrams for ventilation, electrical power and distribution, special mechanical handling, instrumentation and control system architecture	Yes	P&IDs were provided to and used in the hazards analysis. These included a ventilation system P&ID. Mechanical handling equipment and instrumentation and controls are shown on the P&IDs including interlock sequences. The P&IDs are included in Appendices A and F of the Hazards Analysis PRC-STP-00124. One-line electrical power and distribution diagrams (SK-4K-E-003) and instrumentation and control system architecture diagrams (SK-4K-I-001) were provided to the hazards analysis. They were reviewed by the hazards analysis team leader but were not presented and explicitly used in the What-If/Checklist hazard analysis sessions.
	• Summary process design description and sequence of major operations; and	Yes	The hazards analysis was based on the process design description and sequence of major operations as provided by HNF-41051.

Table A-2 Hazard Identification & Control Selection (HI)			
ID #	**Performance Objectives and Criteria[1]**	Met?	**Comments, Basis and Documentation**
HI	***Hazard Identification & Control Selection***		
	• Confinement strategy?	Yes	See response below
	- Are passive and active confinement controls conservatively developed and appropriately implemented [DNFSB 2004-2]? Are any exemptions to the KW ventilation system currently planned?	Yes	The passive and active confinement controls include both safety significant (e.g., hose-in-hose) and defense-in-depth (building ventilation and HEPA filtration) SSCs. The selection of safety significant SSCs was based upon conservative DBA analyses, DOE-STD-1189 Appendices A, B, C, and D, and the DOE-STD-1189 control selection order of preference. Sludge retrieval and transfer activities in the existing KW Basin facility are conducted underwater with the exception of the ingress/egress pipes which provide primary and secondary passive confinement. There are no exemptions to the KW ventilation system currently planned.
HI-4	**Did the hazards analysis performed in the conceptual design phase identify the high cost safety functions and design requirements for the SSCs that will be included in the project, including the following as appropriate:**	Yes	See responses below. Appropriate high cost items have been included in the CD-1 report Chapter 6 "Cost Estimate".
	• Building structure	Yes	The safety functions and NPH criteria for the Modified KW Basin Annex and associated functional requirements are identified in the Control Decision Report PRC-STP-00161 and in the CSDR section 4.4 "Preliminary Selection and Classification of Safety Structures, Systems, and Components."
	• Building and process confinement	Yes	The safety functions and associated functional requirements of safety significant process confinement are identified in the Control Decision Report PRC-STP-00161 and in the CSDR section 4.4 "Preliminary Selection and Classification of Safety Structures, Systems, and Components." The modified KW Basin Annex confinement ventilation system provides a defense-in-depth function.

Table A-2 Hazard Identification & Control Selection (HI)			
ID #	**Performance Objectives and Criteria**[1]	Met?	**Comments, Basis and Documentation**
HI	***Hazard Identification & Control Selection***		
	• Power systems, including those associated with single failure criteria for safety class SSCs	Yes	There are no Safety Class SSCs associated with ECRTS. As discussed in CSDR section 7.3.2, "Design Basis Hydrogen Deflagrations," hydrogen deflagrations are prevented, in part, by active ventilation. During preliminary design the preferred method for preventing hydrogen deflagrations given a loss of power to the ventilation system will be selected. Implementation of options identified-to-date (e.g., safety-significant emergency standby power, use of the argon gas purging system) would not have a large cost or schedule impact.
	• Fire protection provisions; and	Yes	The Modified KW Basin Annex is safety significant with functional requirements established related to fire-rated construction, protection of ventilation ductwork, and building grounding. As discussed in CSDR Section 7.3.3, "Design Basis Fires," the fire suppression system, which provides a layer of defense-in-depth, is classified as general service.
	• Special mechanical equipment (e.g., glove boxes)?	Yes	Safety functions and associated functional requirements for special mechanical equipment providing process confinement (e.g., transfer line service box) are identified in the Control Decision Report PRC-STP-00161 and in the CSDR section 4.4 "Preliminary Selection and Classification of Safety Structures, Systems, and Components."
HI-5	**Did the PHA establish an appropriate suite of Design Basis Accidents (DBAs) to define functional and performance requirements for the facility design?**	Yes	See responses below
	- Are all relevant accident scenarios considered in determining the bounding DBAs (including the spectrum of potential accidents and initiators)?	Yes	All of the hazards identified in the Hazard Analysis PRC-STP-00124 were considered to establish the facility-level design basis accidents. The relevant accident initiators considered for each facility-level design basis accidents are identified in the Accident Analysis PRC-STP-00154.

Table A-2 Hazard Identification & Control Selection (HI)			
ID #	**Performance Objectives and Criteria**[1]	Met?	**Comments, Basis and Documentation**
HI	***Hazard Identification & Control Selection***		
	1. Did the PHA DBAs include internally initiated events such as:	--	
	• Fire	Yes	Internally initiated fires were identified in the Hazard Analysis PRC-STP-00124 as initiators for the spray release and hydrogen deflagration DBAs. Refer to CSDR section 4.3.3 "Fires."
	• Explosion	Yes	Internally initiated explosions were identified in the Hazard Analysis PRC-STP-00124, and are analyzed as DBAs in CSDR section 4.3.2 "Explosions." The explosions analyzed are (1) a hydrogen deflagration in an STSC, and (2) a hydrogen deflagration in the transfer line service box following a loss of primary containment.
	• Loss of containment/confinement	Yes	Internally initiated loss of containment/confinement hazardous conditions were identified in the Hazard Analysis PRC-STP-00124. The Internally initiated loss of containment/ confinement DBA is addressed in CSDR section 4.3.1 "Spray Releases." A spray release is the bounding loss of containment/confinement scenario. Spills and STSC overpressurization scenarios are analyzed in the supporting Accident Analysis PRC-STP-00154.
	• Process upsets	Yes	Internally initiated process upsets were identified in the Hazard Analysis PRC-STP-00124 as initiators for the loss of containment/confinement and explosion DBAs analyzed in CSDR sections 4.3.1 "Spray Releases" and 4.3.2 "Explosions".
	• Inadvertent nuclear criticality?	Yes	The internally initiated nuclear criticality is addressed in CSDR section 4.3.6 "Criticality." The PHA in the Hazard Analysis PRC-STP-00124 did not explicitly identify a nuclear criticality as a hazardous condition resulting from the What-If questions. However, the sludge stored in the six engineered containers in the KW Basin contains more than a minimum critical mass of fissile material such that an inadvertent nuclear criticality must be addressed. Subsequent to the hazard analysis meetings, a criticality safety evaluation (CSE) for the STP was performed as documented in PRC-STP-00163, *Criticality Safety Evaluation*

Table A-2 Hazard Identification & Control Selection (HI)			
ID #	**Performance Objectives and Criteria[1]**	Met?	**Comments, Basis and Documentation**
HI	***Hazard Identification & Control Selection***		
			for Engineered Container and Settler Sludge Retrieval, Transfer, Transportation and Interim Storage (Phase I). The conclusion of the CSE was that based on the analyses that it appears highly likely that the planned transfer of sludge will meet criticality safety requirements with only a few additional controls and limits for transportation. It is likely that a criticality alarm system will not be required.
	2. Did the PHA DBAs include the appropriate externally initiated events?	Yes	Externally initiated events identified in the Hazard Analysis PRC-STP-00124 include range fires, vehicle fires, and aircraft crashes. These may be initiators to spray releases and hydrogen deflagrations and their controls are addressed in the CSDR section 4.3.5. "External Events."
	3. Did the PHA DBAs consider the appropriate NPH initiated events?	Yes	NPH initiated events were identified in the Hazard Analysis PRC-STP-00124, and are addressed in CSDR section 4.3.4. "Natural Phenomena Design Basis Accidents."
HI-6	**Are the hazardous release event evaluations based on facility-level events?**	Yes	The Accident Analysis PRC-STP-00154 and the CSDR Chapter 4.0, "Design Basis Accidents," identify the facility-level events used to develop the hazardous release event evaluations.
HI-7	**For those events with consequences that do not lead to selection of safety class or safety significant controls, does the analysis identify the controls that are appropriate for facility worker, collocated worker, and public defense-in-depth?**	Yes	See response to HI-1 # 6. These are identified on the hazard evaluation tables in the Hazard Analysis PRC-STP-00124.
	• Does the conceptual design incorporate sufficient defense in depth? Are there multiple layers of protection to prevent or mitigate the unintended release of radioactive materials to the environment (e.g., isolation, confinement, successive physical barriers, minimizing MAR, etc.)?	Yes	Multiple layers of defense-in-depth are provided to prevent or mitigate uncontrolled releases. For example, for sludge transfers from an engineered container to an STSC, safety-significant primary and secondary containment with leak detection and overpressure protection is provided. In addition, the Modified KW Basin Annex structure and HEPA-filtered ventilation system provide another layer of defense in depth.

[1]The site should provide the technical bases and assumptions that support the answers provided to each Line of Inquiry. If possible, the review teams should independently verify the technical bases and assumptions.

SAFETY BASIS DOCUMENTATION – *The safety basis documentation supporting STP Phase 1 conceptual design is sufficiently conservative and bounding to be relied upon for the next phase of the project.*

Table A-3 Conceptual Safety Design Report (CR)			
ID #	***Performance Objectives and Criteria[1]***	***Met?***	***Comments, Basis and Documentation***
CR	***Conceptual Safety Design Report (CSDR)***		
CR-1	**Does the CSDR meet the format and guidance criteria in DOE-STD-1189-2008, Appendix H?**	Yes	Addressed in PRC-STP-00156 *Sludge Treatment Project Conceptual Safety Design Report.* See specific responses below.
	1. Does the CSDR include an "Introduction" section that addresses the format and content requirements of DOE-STD-1189-2008 Appendix H including:	--	
	• Facility Mission Overview, and	Yes	Section 1.1 provides the mission overview.
	• Site location?	Yes	Section 1.2 provides the site location.
	2. Does the CSDR include a chapter on "Conceptual Design Description" that addresses the format and content requirements of DOE-STD-1189-2008 Appendix H including:	--	
	• Facility Structure and Layout?	Yes	Section 2.1 provides the facility structures and layout.
	• Process Description?	Yes	Section 2.2 provides the process description.
	3. Does the CSDR include a chapter on "Preliminary Hazard Categorization" that addresses the format and content requirements of DOE-STD-1189-2008 Appendix H including:	--	
	• Hazardous Material Inventories?	Yes	Section 3.1 provides hazardous material inventories.
	• Comparison of Inventories to Threshold Quantities?	Yes	Section 3.2 provides the comparison to Threshold Quantities of DOE-STD-1027-92 Chg Notice 1.
	4. Does the CSDR include a chapter on "Design Basis Accidents" that addresses the format and content requirements of DOE-STD-1189-2008 Appendix H:	Yes	Addressed in Chapter 4.0 "Design Basis Accidents".
	• Facility-Level DBAs?	Yes	Addressed in section 4.1 "Facility Level Design Basis Accidents".
	• Unmitigated DBA Analyses?	Yes	Addressed in section 4.3 "Unmitigated Basis Accidents".
	• Preliminary Selection and Classification of Safety SSCs?	Yes	Addressed in section 4.4 "Preliminary Selection and Classification of safety Structures, Systems, and Components".

Table A-3 Conceptual Safety Design Report (CR)			
ID #	***Performance Objectives and Criteria[1]***	***Met?***	***Comments, Basis and Documentation***
CR	***Conceptual Safety Design Report (CSDR)***		
	5. Does the CSDR include a chapter on "Nuclear Safety Design Criteria" that addresses the format and content requirements of DOE-STD-1189-2008 Appendix H including:	--	
	• Approach for Compliance with Design Criteria	Yes	Section 6.1 "Nuclear Safety Design" provides approach to meeting requirements of DOE O 420.1B.
	• Exceptions to Design Criteria?	Yes	Addressed in Section 6.2 "Exceptions to Design Criteria". (no exceptions identified at this time)
	• Have the safety design requirements and considerations in DOE O 420.1B been addressed in the design?	Yes	Table 6.1 "Approach to Meeting the Requirements of DOE O 420.1B" addresses how the design meets the requirements.
	- Are the classic fire protection safety features that address codes and standards as prescribed in DOE O 420.1B and the Supplemental Contractor Requirements Document (SCRD) incorporated into the conceptual design?	Yes	Many of the design details related to the requirements of DOE O 420.1B, *Facility Safety*, Chapter II, Section 3.c "Fire Protection Design", are outside the scope of conceptual design. The applicable requirements are addressed by the PRC-STP-00171 *Sludge Treatment Project Engineered Container Retrieval and Transfer System Conceptual Design Fire Hazards Analysis*, as follows: (1) Water Supply: The FHA provides a description of the upgrade to the 100K water systems planned to be operational by the end of CY 2010. (2) Noncombustible Construction: The construction of the Modified KW Basin Annex is defined as IBC Type IB. (3) Complete Fire Rated Construction and Barriers: In accordance with the construction type, the primary structural frame and bearing walls shall have a minimum fire resistance rating of 2 hours. The FHA also requires separation of the Modified KW Basin Annex from the existing construction by a 3-hour fire rated barrier. (4) Automatic Fire Extinguishing Systems: The FHA requires an automatic fire sprinkler system, designed to Ordinary Hazard Group 2 at a minimum, for the Modified KW Basin Annex. (5) Redundant Fire Protection Systems: The Control Decision Report PRC-STP-00161 concludes that the highest safety classification of any safety

Table A-3 Conceptual Safety Design Report (CR)			
ID #	***Performance Objectives and Criteria[1]***	***Met?***	***Comments, Basis and Documentation***
CR	***Conceptual Safety Design Report (CSDR)***		
			structure, system, or component for the Modified KW Basin Annex is Safety Significant. The FHA concludes that the Maximum Possible Fire Loss is less than $50M. Therefore redundant fire protection systems are not required. (6) Redundant Safety Class Systems in Separate Fire Areas: The Control Decision Report PRC-STP-00161 concludes that the highest safety classification of any safety structure, system, or component for the Modified KW Basin Annex is Safety Significant. (7) Fire Alarm Systems: The FHA requires a fire alarm system meeting the applicable requirements of NFPA 72, *National Fire Alarm Code*, for the Modified KW Basin Annex. (8) Emergency Egress and Illumination: The FHA classifies the Modified KW Basin Annex as a special purpose industrial occupancy with the hazard of contents classified as "ordinary hazard." The FHA requires compliance with the applicable sections of NFPA 101, *Life Safety Code.* Emergency egress, emergency lighting, and interior finish are specifically addressed. (9) Fire Department Access: The Modified KW Basin Annex is a one-story facility with a simple floor plan. Features such as interior stand pipe systems are neither required nor provided. (10) Containment of Fire Suppression Water: The FHA requires a means for control or containment of fire suppression water in accordance with NFPA 801, *Standard for Fire Protection for Facilities Handling Radioactive Materials.* (11) Unique Fire and Related Hazards: No such hazards have been determined to exist for the Modified KW Basin Annex at the conceptual phase of design.

Table A-3 Conceptual Safety Design Report (CR)			
ID #	***Performance Objectives and Criteria[1]***	***Met?***	***Comments, Basis and Documentation***
CR	***Conceptual Safety Design Report (CSDR)***		
			(12) Inadvertent Operation of Fire Protection Systems: The Control Decision Report PRC-STP-00161 concludes that the highest safety classification of any safety structure, system, or component for the Modified KW Basin Annex is Safety Significant. The CRD 420.1B, Supplemented Rev. 4, provides some clarification of the requirements of DOE O 420.1B, and general supplemental requirements. Many of these design details are outside the scope of conceptual design. The requirements are addressed by the PRC-STP-00171 *Sludge Treatment Project Engineered Container Retrieva and Transfer System Conceptual Design Fire Hazards Analysis*, as follows: (1) Water Supply: The design of the 100K water systems upgrade, as it pertains to the supply for the 105-KW Basin and the Modified KW Basin Annex, is believed to meet all the requirements of the Section B, Item 7. (2) Fire Suppression: The FHA uses the thresholds provided by Section D, Item 1 in making the determination that an automatic fire sprinkler system is required. (3) Fire Protection Design Criteria: The FHA calls out the applicable requirements of DOE-STD-1066-99, *Fire Protection Design Criteria*. The standard is also included in the project Functional Design Criteria. (4) DOE Fire Protection Handbook: The design requirements of the Fire Protection Handbook, Hanford Chapter, are beyond the scope of conceptual design. (5) Fire Barriers: In accordance with the construction type, the primary structural frame and bearing walls shall have a minimum fire resistance rating of 2 hours. The FHA also requires separation of the Modified KW Basin Annex from the existing construction by a 3-hour fire rated barrier. Interior fire barriers were not designated within the scope of the

Table A-3 Conceptual Safety Design Report (CR)			
ID #	***Performance Objectives and Criteria***[1]	***Met?***	***Comments, Basis and Documentation***
CR	***Conceptual Safety Design Report (CSDR)***		
			conceptual design. (6) Interior Finish: The FHA addresses the interior finish requirements for nuclear facilities as specified by Section D, Item 6.
	- Have ALARA results been input into the conceptual design as prescribed in 10 CFR 835 subpart K?	Yes	The ALARA design requirements from 10 CFR 835 Subpart K have been incorporated into the design of the KW Annex facility and have been documented in PRC-STP-00137, Rev. A, "*Sludge Treatment Project Engineered Container Retrieval and Transfer System ALARA Design Analysis*" (included as Appendix A of CD-1 Report, PRC-STP-00166).
	- Is the Annex ventilation and shielding design and are the controls and operational methods for disconnecting lines to the STSC protective of the worker during off-normal and upset conditions	Yes	Shielding considerations are documented in PRC-STP-00102, Rev. 1, "*Finalized Revision to Preliminary Shielding Calculations for Direct Loading of K-Basins Sludge*" (included as Appendix B of CD-1 Report, PRC-STP-00166). Workers are not present in areas that would see airborne activity or radiation in excess of permitted levels during off-normal or upset conditions. Recovery from these conditions would be governed by pre-approved response procedures. These procedures would ensure that worker dose is maintained ALARA. Addressed in the ECRTS ALARA Design Analysis STP-PRC-00137.
	- Does the planned operating envelop safely support radiation/contamination controls, maintenance and operation of all components?	Yes	The ECRTS design has incorporated ALARA features into the design to facilitate maintenance and operations; this has been documented in the ECRTS ALARA Design Analysis PRC-STP-00137.
	- Have all radiation protection risks been identified and addressed; do any remain?	Yes	The ECRTS design incorporates design features to reduce the radiological risk to workers and this had been documented in the ECRTS ALARA Design Analysis PRC-STP-00137.
	- Has the design of the STP followed ISM principals for the protection of the workers, public and environment?	Yes	The design of the STP is being accomplished in accordance with the CHPRC requirements and procedures which have been developed to fully implement ISM principles for the protection of the workers, public and the environment.

Table A-3 Conceptual Safety Design Report (CR)			
ID #	***Performance Objectives and Criteria[1]***	***Met?***	***Comments, Basis and Documentation***
CR	***Conceptual Safety Design Report (CSDR)***		
	- Have all material handling risks been identified and addressed; do any remain (e.g., any unmitigated radiological exposures created by material handling)?	Yes	Material handling risks have been identified consistent with the conceptual stage of the design. The two materials being handled that pose a material handling risk are (1) the sludge, and (2) the argon that will be used for inerting the STSC and STS cask. The Hazards Analysis documented in PRC-STP-00124 identifies both direct radiation and loss of containment/confinement hazards associated with sludge handling and their controls. PRC-STP-00124 also identifies the asphyxiation hazard posed by the use of argon and its controls.
	• Have the appropriate NPH criteria from DOE Order O 420.1B and its guidance documents as modified by DOE-STD-1189 Appendix A been determined and all are addressed in the CSDR?	Yes	Items 25 through 34 of the CSDR Table 6.1 "Approach to Meeting the Requirements of DOE O 420.1B" addresses the NPH criteria of DOE O 420.1B as modified by DOE-STD-1189.
	- Are there any known disagreements from oversight organizations regarding the determination of a Seismic Design Category SDC-3 Limit State D?	--	There are no known disagreements from oversight organizations regarding the SDC-3, Limit State D determination for the Modified KW Basin Annex and associated Safety Significant SSCs.
	- Are any exemptions associated with backfitting issues for non-seismic NPH DBAs planned at this time?	--	At this time there are no planned exemptions associated with backfitting issues for non-seismic NPH DBAs. The new KW Annex should not have any adverse interactions with the existing structures regarding non-seismic DBAs.
	• Have the structural and utilities interfaces between the new KW Basin Annex with the KW structure been adequately considered?	Yes	Addressed in CD-1 report, Appendix E "Interface Control"
	- Are any exemptions due to backfitting issues associated with the interfaces planned at this time?	--	At this time there are no planned exemptions associated with the structural and utility interfaces.
	6. Does the CSDR include a chapter on “Other Considerations” that addresses the format and content requirements of DOE-STD-1189- 2008 Appendix H including:	Yes	Addressed in Chapter 7 "Other Considerations".
	• Planned Studies and Analyses	Yes	Addressed in Section 7.1 "Planned Studies or Analyses"
	• Safety-in-Design Risks and Opportunities	Yes	Addressed in Section 7.2 "Safety-in-Design Risks and Opportunities".

Table A-3 Conceptual Safety Design Report (CR)			
ID #	***Performance Objectives and Criteria[1]***	***Met?***	***Comments, Basis and Documentation***
CR	***Conceptual Safety Design Report (CSDR)***		
	• Lessons Learned from Previous Exper • ience Involving Major Systems?	Yes	Addressed in Section 7.3 Lessons Learned from Previous Experience Involving Major Systems".
	- Have appropriate lessons learned from the previous KE to KW hose-in-hose transfer project been applied, both from a process design and safety basis perspective?	Yes	Per discussions with design staff, lessons learned from previous hose-in-hose transfers have been incorporated. Safety functions and associated functional requirements for special mechanical equipment providing process confinement (e.g., transfer line service box) are identified in the Control Decision Report PRC-STP-00161 and in the CSDR section 4.4 "Preliminary Selection and Classification of Safety Structures, Systems, and Components."
	7. Is the DOE RL Conceptual Safety Validation Report (CSVR) being prepared per the conceptual design approval bases from DOE-STD-1104-2009, *Review and Approval of Nuclear Facility Safety Basis and Safety Design Basis Documents*?	Yes	The RL Safety Basis Review Team (SBRT) has completed its review of the CSDR and supporting documents and is in the process of drafting the CSVR using the guidance from DOE-STD-1104-2009. Approval of the CSVR will be recommended to the DOE RL Approval Authority.
	• Are there issues in the CSDR or PHA that warrant the equivalent of DOE Conditions of Approval (COAs), and will they be formally tracked for closure as soon as practicable, or planned to be closed during the development of the Safety Evaluation Report for the CD-2/CD-3 Preliminary Documented Safety Analysis?	Yes	Other than incorporating the agreed-to resolutions to the SBRT review comments, no COAs to resolve specific issues have been identified.

[1]The site should provide the technical bases and assumptions that support the answers provided to each Line of Inquiry. If possible, the review teams should independently verify the technical bases and assumptions.

SAFETY BASIS DOCUMENTATION – *The safety basis documentation supporting STP Phase 1 conceptual design is sufficiently conservative and bounding to be relied upon for the next phase of the project.*

Table A-4 Risks to Project Safety Decisions (PR)

ID #	***Performance Objectives and Criteria[1]***	***Met?***	***Comments, Basis and Documentation***
PR	***Risks to Project Safety Decisions***		
PR-1	**Has the Safety-in-Design Risk and Opportunity Assessment been developed?**	Yes	Addressed in PRC-STP-00164 *Sludge Treatment Project Engineered Container Retrieval and Transfer System Risk and Opportunity Assessment.* See responses below.
	1. Does the Safety-in-Design Opportunity Assessment interface with the project risk management plan consistent with the guidance and expectations identified in DOE-STD-1189-2008, Appendix F?	Yes	The checklist of considerations in DOE-STD-1189 Appendix F as well as the hazard and accident analysis results were considered as documented on PRC-STP-00164 Table 1 "Evaluation of Candidate Design Risks from DOE-STD-1189, Table F-1". The CD-1 report section 3.2.11 "Risk and Opportunity Assessment" acknowledges that PRC-STP-00164 is input to the STP Risk Management Plan.
	2. Have all structural risks been identified and addressed; do any remain? Since the results of the 10-year update required by DOE Order O 420.1B to the Hanford NPH criteria will not be known until 2012 - 2013, has a sufficiently conservative approach been selected in the interim to establish Design Basis NPH criteria (all NPH, not just seismic)?	Yes	Addressed in PRC-STP-00164 page 1-8, "Seismic Update for the Hanford Site", and the CSDR section 7.2 "Safety-in-Design Risks and Opportunities". The conservative input is being developed as part of preliminary design.
	3. At conceptual design, are there any planned exemptions to any codes and standards not identified by the above review criteria?	--	No exemptions are planned.
	4. At conceptual design, have any equivalencies to applicable EC/ST Phase 1 codes and standards been made by the design authority or the DOE RL approval authority (e.g., RL Manager, RL Authority Having Jurisdiction, etc.)? If so, are levels beyond DOE RL approval planned?	--	No equivalencies have been requested.

[1]The site should provide the technical bases and assumptions that support the answers provided to each Line of Inquiry. If possible, the review teams should independently verify the technical bases and assumptions.

SAFETY BASIS DOCUMENTATION – *The safety basis documentation supporting STP Phase 1 conceptual design is sufficiently conservative and bounding to be relied upon for the next phase of the project.*

Table A-5 Safety Design Integration Team – Interfaces and Integration (II)			
ID #	***Performance Objectives and Criteria[1]***	***Met?***	***Comments, Basis and Documentation***
II	***Safety Design Integration Team – Interfaces and Integration***		
II-1	**Does the Safety Design Integration include the interface organizations and activities identified in Table 7-1 of DOE-STD-1189-2008 as appropriate?**	Yes	Interface organizations and activities are identified in the SDS, section 6.0 "Safety-in-Design Integration Team – Interfaces and Integration", and in the SDIT charter HNF-35063, Rev. 6, *Sludge Treatment Project Safety Design Integration Team Charter*. The PRC-STP-00111 *STP Contractor Integrated Project Team Charter* (CITP) identifies core membership that includes some of the SDIT members. Interfaces extend beyond the SDIT and CIPT as identified in the PRC-STP-00166 CD-1 report Chapter 3 "Conceptual Evaluations".
II-2	**Do the interfaces include (as appropriate):**	--	
	• Quality Assurance	Yes	Included in the PRC-STP-00111 charter Table 1 "CIPT Core Membership". Addressed in PRC-STP-00166 CD-1 report section 3.4.1 "Quality Analysis/Quality Assurance Program Plan".
	• Fire Protection	Yes	Included in the HNF-35063 charter Table 1 "Safety Design Integration Team Core Membership" and in the PRC-STP-00111 charter Table 1 "CIPT Core Membership". Addressed in PRC-STP-00166 CD-1 report section 3.2.10 "Preliminary Fire Hazards Analysis".
	• Criticality Safety	Yes	Included in the HNF-35063 charter section 2.2 as a supporting specialist. Addressed in PRC-STP-00166 CD-1 report section 3.2.6 "Criticality".

Table A-5 Safety Design Integration Team – Interfaces and Integration (II)			
ID #	***Performance Objectives and Criteria[1]***	***Met?***	***Comments, Basis and Documentation***
II	***Safety Design Integration Team – Interfaces and Integration***		
	• Radiological Protection	Yes	Included in the HNF-35063 charter Table 1 "Safety Design Integration Team Core Membership" and in the PRC-STP-00111 charter Table 1 "CIPT Core Membership". Addressed in PRC-STP-00166 CD-1 report section 3.3 "As Low As Reasonable Achievable".
	• Human Factors	Yes	Included in the Health and Safety membership to the SDIT (HNF-35063), but also considered by all safety disciplines during their reviews, as well as by Design Authorities.
	• Security	Yes	Included in the HNF-35063 charter section 2.2 as a supporting specialist. Addressed in PRC-STP-00166 CD-1 report section 3.6 "Safeguards and Security".
	• Environmental Protection	Yes	Included in the HNF-35063 charter section 2.2 as a supporting specialist. Addressed in PRC-STP-00166 CD-1 report section 3.7 "Environmental".
	• Hazardous Materials	Yes	Included in the Health and Safety membership to the SDIT (HNF-35063). Addressed in PRC-STP-00166 CD-1 report section 3.4 "Environmental, Safety, and Health Management Planning".
	• Radiological and Hazardous Waste Management	Yes	Included in the HNF-35063 charter section 2.2 as a supporting specialist. Addressed in PRC-STP-00166 CD-1 report section 3.7 "Environmental".
	• Emergency Preparedness	Yes	Included in the HNF-35063 charter section 2.2 as a supporting specialist. Addressed in PRC-STP-00166 CD-1 report section 3.5.9 "Emergency Preparedness".

Table A-5 Safety Design Integration Team – Interfaces and Integration (II)			
ID #	***Performance Objectives and Criteria[1]***	***Met?***	***Comments, Basis and Documentation***
II	***Safety Design Integration Team – Interfaces and Integration***		
	• External Reviews	Yes	The DOE RL *Sludge Treatment Project, EC/ST Disposition Sub-project Phase I, Critical Decision – 1 Readiness Plan*, Rev. 1, defines the DOE RL review plan. In addition, the CSDR and supporting documentation are being reviewed to recommend approval to the DOE RL Approval Authority. Other non-DOE external reviews are defined in the DOE RL "Sludge Treatment Project Federal Integrated Project Team Charter", Appendix A to the *Sludge Treatment Project Project Execution Plan.*
	• System Engineer Program	No	This subject matter was deemed by the STP Project not applicable for Conceptual Design Phase
	• Procedures, Training and Qualification?	No	This subject matter was deemed by the STP not applicable for Conceptual Design Phase
II-3	**Do these interfaces address the appropriate resource requirements and guidance as identified in Table 7-1?**	Yes	Resources have been made available to support the SDIT and CIPT as defined in those charters.

[1]The site should provide the technical bases and assumptions that support the answers provided to each Line of Inquiry. If possible, the review teams should independently verify the technical bases and assumptions.

TRANSPORTATION SAFETY– *The transportation safety documentation supporting STP Phase 1 conceptual design is sufficiently conservative and bounding and applicable controls are appropriate to support transporting STP sludge to T Plant.*

Table A-6 Transportation Safety (TS)			
ID #	**Performance Objectives and Criteria[1]**	Met?	**Comments, Basis and Documentation**
TS	***Transportation Safety***		
TS-1	**Is the overall approach (or transportation safety design strategy) to developing and approving the transportation safety basis documents for transferring the sludge to T Plant appropriate for the STP conceptual design?**	Yes	The STP Engineered Container Retrieval and Transfer System (ECRTS) plans to transport packaged sludge in the existing Sludge Transport System (STS) with a newly designed STS payload container called the Sludge Transport and Storage Container (STSC). The STS was specifically designed, built, and qualified to transport large quantities (2 to 3 cubic meters) of sludge with Type-B levels of activity from the K-Basin to T-Plant for interim storage. The STS, currently comprised of the STS cask, the authorized payload container (called the Large Diameter Container, or LDC), and the STS trailer was originally authorized to transport a 60% to 40% by volume mixture of KE Basin floor and canister sludge packaged in the LDC. The ECTRS sludge characteristics and the STSC vary enough from the original authorization document that a new or revised transportation safety document is required. Requirements associated with preparation and transport of hazardous materials on the Hanford Site are contained in U.S. Department of Energy (DOE), Richland Operations Office (RL), DOE/RL-2001-36, *Hanford Sitewide Transportation Safety Document* (TSD) and PRC-RD-TP-7900, *Transportation and Packaging Program Requirements*. CHPRC administrative procedure PRC-PRO-TP-15665, *Transportation Safety Documents*, provides the requirements and processes for the development of transportation safety documents that demonstrate equivalent safety to the Hazardous Materials Regulations (Title 49 *Code of Federal Regulations* [CFR] Parts 171-180) for onsite transportation activities under DOE/RL-2001-36, *Hanford Sitewide Transportation Safety Document* (TSD).

Table A-6 Transportation Safety (TS)			
ID #	**Performance Objectives and Criteria[1]**	Met?	**Comments, Basis and Documentation**
TS	***Transportation Safety***		
			The STP ECRTS has developed and is implementing the *Sludge Treatment Project – Engineered Containers Transportation Safety Document Plan* (PRC-STP-00200). The objective of the plan is to identify, develop, and ultimately receive approval from DOE RL on the appropriate type of transportation safety document that authorizes the transport of the ECRTS sludges in the STS. As required by PRC-PROTP-15665, the Plan has been shared with, and commented on by DOE RL.
TS-2	**Is the conceptual design for transportation safety based on conservative assumptions and analyses that are consistent with the Criticality Safety Evaluation Report (CSER) for the planned waste packaging?**	Yes	A preliminary criticality safety evaluation was performed utilizing the conservative safety basis values for each of the ECRTS sludge sub-populations (*PRC-STP-00163, January 2010, Criticality Safety Evaluation for Engineered Container and Settler Sludge Retrieval, Transfer, Transportation, and Interim Storage (Phase I)*). The scope of this evaluation included the loading of the sludge into the STS/STSC at K-Basin, the transport of the sludge from K-Basin to T-Plant using the STS/STSC, and the interim storage of the full STSCs at T-Plant. From the transportation perspective, the report concluded that the transport of the ECRTS sludges in the STS/STSC did not introduce any new scenarios that were not already bounded by previous CSERs (09-004, Frinrock 2009, and 04-026, Erickson 2007). The new STS transportation safety document will utilize a new CSER developed specifically for the transport of the ECRTS sludge inventory in the STS. The CSER will also utilize conservative conditions representing the highest activity sludge and the maximum sludge loading conditions. Conditions to be evaluated and demonstrated as safe per the DOE/RL-2001-36, *Hanford Sitewide Transportation Safety Document* (TSD) in the new CSER were presented and approved by DOE SED in *Criteria for Criticality Safety Evaluation CSER Supporting Site Shipment of K Basin Sludge, Jan. 2010.* Per *Sludge Treatment Project – Engineered*

Table A-6 Transportation Safety (TS)			
ID #	**Performance Objectives and Criteria[1]**	Met?	**Comments, Basis and Documentation**
TS	***Transportation Safety***		
			Containers Transportation Safety Document Plan, PRC-STP-00200, a new CSER will be performed and included in the new transportation safety document.
TS-3	**Is the conceptual design for transportation safety based on conservative assumptions and analyses that demonstrate planned shielding will achieve compliance with surface dose rate limits established in the transportation safety basis?**	Yes	Preliminary/screening shielding calculations *(Finalized Revision to Preliminary Shielding Calculations for Direct Loading of K-Basins Sludges*, PRC-STP-00102, Rev. 1) were performed with worst-case sludge activities (safety basis values for Settler tube sludge) and sludge loadings conditions that indicated that the dose rates associated with the transport of the EC sludges will be within the TSD allowable limits. Per *Sludge Treatment Project – Engineered Containers Transportation Safety Document Plan*, PRC-STP-00200, new shielding calculations will be performed and included in the new transportation safety document. Ultimately, compliance will be demonstrated by actual dose rate measurements of the loaded cask.
TS-4	**Is the conceptual design for transportation safety based on conservative assumptions and analyses that demonstrate expected hydrogen gas and heat generation values will not exceed the gas generation and thermal limits established in the transportation safety basis?**	Yes	Preliminary gas and thermal evaluations have been performed using the conservative safety basis inventory values (PRC-STP-00220, *Sludge Treatment Project Engineered Container Retrieval and Transfer System – Thermal and Gas Analyses for STSC Loaded with KW Engineered Container Sludge*. Results of the gas and thermal evaluation are discussed in *Preliminary STP Container and Settler Sludge Process System Description and Material Balance* (HNF-41051). These conservative evaluations indicate that gas and thermal conditions may limit the amount of Settler Sludge placed into the STS/STSC, while the K-East and K-West sludge inventories will not be limited by gas and thermal conditions. Per *Sludge Treatment Project – Engineered Containers Transportation Safety Document Plan*, PRC-STP-00200, new gas and thermal calculations will be performed and included in the new transportation safety document.

[1]*The site should provide the technical bases and assumptions that support the answers provided to each Line of Inquiry. If possible, the review teams should independently verify the technical bases and assumptions.*

SAFEGUARDS & SECURITY – *The conceptual design is consistent with safeguards and security approvals.*

Table A-7 Safeguards & Security (SS)

ID #	Performance Objectives and Criteria[1]	Met?	Comments, Basis and Documentation
SS	***Safeguards & Security***		
SS-1	**Does the Phase 1 process as described in the conceptual design incorporate the physical security and control / accountability requirements as specified in the most recent safeguards deviation approved by RL? [Currently – January 8, 2010, 10-SES-0054]**	Yes	Protection measures have been applied to both the physical security and material control and accountability. The special nuclear material (SNM) content for the sludge is determined by calculation rather than direct measurement. The calculation involves multiplying a measured quantity (mass or volume of sludge) by the calculated concentration determined from characterization data. Means for measuring the mass or volume of the sludge is incorporated into the conceptual design. The compliance based physical security measures have been incorporated into the design. Nuclear facility safety, radiological, and shipping controls will have more stringent restrictions and bound the physical security and NMC&A requirements. Documented in: CHPRC-0900741, December 2009, *Request for Variance from U.S. Department of Energy Order Requiring Nuclear Material Measurement and Measurement Control Programs When Packaging K East Basin Sludge and K West Basin Sludge*, CH2MHILL Plateau Remediation Company, Richland, Washington. 10-SES-0054, January 2010, DOE approval of CHPRC-0900741 Request, Department of Energy Richland Operations Office. SAS-SA2009-003, January 2010, *Limited Security Assessment for the Sludge Treatment Project*, Mission Support Alliance, Safeguards and Security. PRC-STP-00156, February 2010, *Sludge Treatment Project Engineered Container Retrieval And Transfer Conceptual Safety Design Report*, CH2MHILL Plateau Remediation Company, Richland, Washington.

Table A-7 Safeguards & Security (SS)			
ID #	**Performance Objectives and Criteria[1]**	Met?	**Comments, Basis and Documentation**
SS	***Safeguards & Security***		
SS-2	**Has a preliminary security Vulnerability Assessment been completed during the conceptual design phase and factored into the Preliminary Hazards Analysis?**	Yes	A Vulnerability Assessment (VA) is completed for a facility containing Category I and II (with rollup) quantities of SNM. The SNM quantities for this project do not meet the criteria for a VA. A Limited Security Assessment (LSA) is performed for Category II, III, and IV facilities/assets. An LSA for the Sludge Treatment Project (STP) has been performed and determined the facilities and activities are required to meet compliance based standards for safeguards accountability and security operations based on existing DOE directives and commonly accepted business practices. The compliance based physical security measures have been incorporated into the design. Nuclear facility safety, radiological, and shipping controls will have more stringent restrictions and bound the physical security and NMC&A requirements. Documented in: SAS-SA2009-003, January 2010, *Limited Security Assessment for the Sludge Treatment Project*, Mission Support Alliance, Safeguards and Security. PRC-STP-00156, February 2010, *Sludge Treatment Project Engineered Container Retrieval And Transfer Conceptual Safety Design Report*, CH2MHILL Plateau Remediation Company, Richland, Washington.
SS-3	**Does the CSDR include a chapter on "Security Hazards and Design Implications" that addresses the format and content requirements of DOE-STD-1189-2008 Appendix H?**	Yes	Chapter 5 of the CSDR, PRC-STP-00156, February 2010, *Sludge Treatment Project Engineered Container Retrieval And Transfer Conceptual Safety Design Report*, CH2MHILL Plateau Remediation Company, Richland, Washington.

Table A-7 Safeguards & Security (SS)			
ID #	**Performance Objectives and Criteria[1]**	Met?	**Comments, Basis and Documentation**
SS	***Safeguards & Security***		
SS-4	**Have any a preliminary safeguards and security deviations or variances been completed during the conceptual design phase and factored into the PHA?**	Yes	There is one deviation approved for the K-basin material and an approved termination of safeguards on the attractiveness level D plutonium contained in the K basin material. No preliminary safeguards deviations have been prepared because it highly likely that all the material will be bounded by the current approved deviation and termination. If not, the changes to the current documents will be minor and nuclear facility safety, radiological, and shipping controls will have more stringent restrictions and bound the physical security and NMC&A requirements in the design. Documented in: CHPRC-0900741, December 2009, *Request for Variance from U.S. Department of Energy Order Requiring Nuclear Material Measurement and Measurement Control Programs When Packaging K East Basin Sludge and K West Basin Sludge*, CH2MHILL Plateau Remediation Company, Richland, Washington. 10-SES-0054, January 2010, DOE approval of CHPRC-0900741 Request, Department of Energy Richland Operations Office. FH-0500438, March 2006, *Request for Termination of Safeguards on Attractiveness Level "D" Plutonium Contained in K-West Basin Sludge*, Fluor Hanford, Inc. 06-SES-0192, August 2006,DOE approval of FH-0500438, of Energy Richland Operations Office PRC-STP-00156, February 2010, *Sludge Treatment Project Engineered Container Retrieval And Transfer Conceptual Safety Design Report*, CH2MHILL Plateau Remediation Company, Richland, Washington.

[1] *The site should provide the technical bases and assumptions that support the answers provided to each Line of Inquiry. If possible, the review teams should independently verify the technical bases and assumptions.*

Appendix B TIPR Charter

Office of Environmental Management

Team Charter

for the

Technical Independent Project Review (TIPR)

of the

Sludge Treatment Project (STP) - Phase 1
Engineered Container / Settler Tube
Retrieval and Transfer to T Plant
Subproject

of the 100 Area K Basin Closure Project
PBS RL-012

16 April 2010

Concur: [signature] 4-15-2010
Tom Teynor - Federal Project Director
K Basins Closure Project
Date

Approved: [signature] 4/15/10
Herb Sutter - TIPR Team Leader
Date

U.S. Department of Energy
Richland Operations Office

Introduction

In accordance with DOE Order 413.3A[1] dated July 26, 2006; the U.S. Department of Energy (DOE) Office of Safety & Security / Chief Nuclear Safety is conducting a Technical Independent Project Review (TIPR) for the Engineered Container / Settler Tube (EC/ST), Phase 1 Subproject, which is an activity within the K Basins Closure Sludge Treatment Project at the Hanford Site. This review is requested by the K Basins Closure Federal Project Director (FPD) and the Sludge Treatment Project Subproject Director (SPD) in the DOE Richland Operations Office (RL) to ensure that conceptual design plans and assumptions are sufficiently conservative and bounding to proceed with the next phase of design development. Additional areas of focus for the TIPR include areas of interest where the project may have risks. This TIPR provides an independent assessment of the potential vulnerabilities and where appropriate, provides recommendations where corrective actions may be necessary in order to increase confidence.

To meet this request, the TIPR team will implement a strategy and at the discretion of the Team Leader, use the guidance provided in DOE G 413.3 G-9, *Review Guidance for Independent Project Reviews*, and the Standard Review Plan, *Conceptual Safety Design Review Module*[2], as appropriate. The TIPR Team Leader, working with the RL KBCP FPD and STP SPD, has identified areas of specific interest / focus which are listed below. Lines of Inquiry for each of these key areas of focus are provided in order to assist the individual reviewers identified in this Charter.

- Safety Basis Documentation
- Transportation Safety
- Safeguards and Security

Background

The Sludge Treatment Project (STP) is a non-major system project that is subject to the requirements of DOE Order 413.3A. The STP is comprised of three stand alone sub-projects, the Knockout Pot (KOP) Disposition, the Engineered Container / Settler Tube (EC/ST) Disposition Phase 1 and EC/ST Phase 2. The Critical Decision (CD) requirements of the order are being applied to the EC/ST Phase 1 subproject. The EC/ST Phase 1 subproject is preparing for CD-1. The safety basis strategy for the KOP Disposition subproject is to authorize activities and minor modifications under the current safety basis documentation at Hanford for multiple facilities, evaluating the proposed changes through the Unreviewed Safety Question Determination process and/or development of safety basis amendments for DOE RL approval, and is not within the scope of this TIPR. However, the 10 CFR 830 major modification determinations will be reviewed by the TIPR. The EC/ST Phase 2 subproject is also not within the scope of this TIPR.

DOE Order 413.3A, Table 2, CD Requirements, establishes prerequisites and requirements for CD approvals. Readiness preparations for CD-1 approval include the performance of a Design Review DR) of the conceptual design and a project review for CD-1. As a specific component of the DR, a Technical Independent Project Review [3] (TIPR) is required to independently verify

[1] DOE O 413.3A, Program and Project Management for the Acquisition of Capital Assets, 7-28-06.
[2] DOE Environmental Management Standard Review Plan, Conceptual Safety Design Review Module (2nd Edition, March 2010)
[3] DOE G 413.3-9, Project Review Guide, Section 3.4, Technical Independent Project Reviews

that the safety basis documentation is sufficiently conservative and bounding and that safeguards and security has been appropriately considered during CD-1. The TIPR is not intended to duplicate the DOE RL technical review of the adequacy of the CD-1 design submittal, such as compliance with safety-related design codes and standards, e.g., radiation protection per 10 CFR 835 Subpart K Design and Control, fire protection, safety and health, environmental, etc.. That review will determine whether the products (drawings, analysis, or specifications) are correct and will perform their intended functions and meet requirements. The DOE RL review will also ensure that the conceptual design package has adequately implemented the safety-in-design process to integrate safety in the design development process.

The project review is a broad evaluation of the project maturity of the supporting programs and documents at the conceptual stage of development. Some components of the project review that fall under the definition of TIPR already have been performed at appropriate times in order to be effective for the development of the concept. An External Technical Review (ETR) performed in March 2009 [4] evaluated the areas of project management, technical risks, regulatory risks, system risks, and safety risks. The ETR found that the two phased approach for the STP EC/ST was appropriate. Several recommendations resulting from the ETR have been incorporated into the project planning and technology development. Phase 1 testing and technology demonstrations of the technical elements of the conceptual design determined that the critical technical elements needed to perform their functions were feasible. A Technology Readiness Assessment (TRA) completed in October 2009 [5] confirmed the technical readiness level to support CD-1.

Scope of Review

<u>Safety Basis Documentation</u> – principle objective of this TIPR, DOE Order 413.3A, Table 2, Requirements for CD-1 states in part:

> *"As an element of the Design Review, for high-risk, high-hazard, and Hazard Category 1, 2, and 3 nuclear facilities, conduct a Technical Independent Project Review, the focus of which is to determine that the safety documentation is sufficiently conservative and bounding to be relied upon for the next phase of the project."*

- This review will provide an independent verification of the CD-1 safety basis documents to confirm that analyses' and decisions are sufficiently conservative and bounding. It focuses on safety design package key elements including the safety design strategy, safety guidance and requirements, hazards identification and control selection, Conceptual Safety Design Report, risks to project safety decisions, and safety design integration team interactions.
- The documents specifically identified for this review include:
  1. HNF-34374, Revision 3, February 2010, the STP Safety Design Strategy (SDS)
  2. RL 10-SED-0034, Approval of Updated STP SDS, dated Jan 25, 2010 for the SDS Revision 2 and the draft RL approval for the STS Revision 3
  3. PRC-STP -00156, Conceptual Safety Design Report (CSDR), dtd 1-19-2010
  4. Draft RL Conceptual Safety Validation Report (CSVR) approving the CSDR

[4] External Technical Review of the Hanford K Basins Sludge Treatment Project dated June 2009
[5] Sludge Treatment Project Phase 1Technical Readiness Assessment Report dated October 2009

- Other documents referenced in or supporting the above listed documents, e.g., hazards and accident analyses, preliminary fire hazards analysis, and preliminary criticality safety evaluations, will be made available to the review as necessary.

Transportation Safety– DOE STD 1189 does not include the transportation safety basis. The Hanford Site-wide Transportation Safety Document (TSD) for onsite Transportation and Packaging at Hanford, approved by RL, authorizes methods described in the TSD to comply with 10 CFR 830.207a and DOE O 460.1A, Attachment 1, Criteria 5. The appropriateness of the conceptual plan for packaging and transport should be confirmed

- This review will provide an independent verification that the strategy for developing the transportation safety basis documents is consistent with requirements
- The documents specifically identified for this review include:
  1. PRC-STP-00200, Rev 0, date, Sludge Treatment Project Transportation Safety Basis Documentation Plan
  2. DOE/RL – 2001-36, Rev 1-C, Jun09, Hanford Site-wide Transportation Safety Document (TSD)
  3. PRC-PRO-TP-15665, Rev 0, Chg 2, Oct '09, Transportation Safety Basis Documents
  4. PRC-RD-TP-7900, Revision 1, Chg 2, October 2009, Transportation and Packaging Program Requirements
  5. STP specific documents that document the TSD strategy and methodology (PSSD versus SPA), evaluate criticality, shielding and analyze gas & thermal generation.

- Other documents referenced in or supporting the above listed documents will be made available to the review as necessary.

Safeguards & Security – Nuclear material accountability and controls are required for sludge in the K West Basis and the methods that involve deviations from requirements for managing all of the process steps must be planned and integrated into the STP operations. The current safeguards deviation approval, documented in 10-SES-0054, 8 January 2010, identifies conditions and controls that affect the STP activities.

- This review will provide an independent verification that the conceptual design has integrated the conditions and controls that are required for material control and accountability
- The documents specifically identified for this review include:
  1. SAS-SA2009-003, Limited Security Assessment for the STP, January 2010 –
  2. 10-SES-0054, DOE-RL Letter, Brockman to Lehew January 8 2010, Approval of deviation from Nuclear Material Measurement and Measurement Control Programs when Packaging K Basin Sludge
  3. CHPRC-0900741, December 4, 2009, PRC Letter to RL requesting approval of deviation from Nuclear Material Measurement when packaging K Basin Sludge
  4. HNF-41051, Rev 5 - Preliminary STP Container and Settler Sludge Process System Description Material Balance

- Other documents referenced in or supporting the above listed documents will be made available to the review as necessary.

Team

This TIPR is a component of the conceptual design review which is independent from the project. The TIPR Team Leader, selected by the K Basins Closure Project FPD in consultation with EM-21 and EM HQ Chief of Nuclear Safety, is independent of the STP and RL programmatic oversight. The activities identified in this plan are performed by a team of subject matter experts identified by the TIPR Team Leader in collaboration with EM HQ Chief of Nuclear Safety, the RL KBCP FPD and RL STP SPD. The individuals on the TIPR Team are listed in the table below and summary biographies are included in the attached enclosure.

The review methodology will be developed by the TIPR Team Leader. The focus areas identified in this TIPR Charter define the scope of the review and the Lines of Inquiry (LOIs) are provide to guide the reviewers in their investigation of their areas of the review – reviewers will develop the appropriate criterion, requirements and approaches for assessing each LOI. Documentation will be at the discretion of the TIPR Team Leader and will follow the guidelines provided in DOE G 413.3 -9 Project Review Guide and the CSDR Standard Review Plan. A final report will be issued by the TIPR Team Leader and provided to the RL KBCP FPD and STP SPD

Name	Functional Area
Dr. Herb Sutter, *Team Leader*	Nuclear Safety Basis
Dr. Naeem Abdurrahman	Nuclear Safety Basis
Terry Foppe	Nuclear Safety Basis
Bob Hynes	Transportation Safety
Tim Hayes	Safeguards & Security, Safety Basis

Period of Performance

The schedule for performance of this TIPR begins near the end of the RL review of the Conceptual Design Report (CDR). Key to starting the TIPR is that the RL STP SPD is satisfied that the CDR is ready to be subjected to an independent review. A significant focus area is the safety basis documentation supporting the conceptual design. The Safety Design Strategy (SDS) and the Conceptual Safety Design Report (CSDR) are components of the CDR. The CDR package was delivered to RL February 23, 2010. RL will complete its design review April 26, 2010 and the Conceptual Safety Validation Report (CSVR) will be in its final draft form and available for the TIPR. The CSVR is the RL document which provides the basis for approval. At that time, the RL STP SPD will determine that the project is ready for the start of the TIPR. The TIPR on-site activities are planned for May 3 to May 7, 2010 with the final report issued June 4, 2010. The results from the TIPR will be incorporated into the RL CSVR if appropriate prior to its approval by the RL Manager. Contingent upon a satisfactory outcome from the TIPR, the RL Manager approval of CD-1 is scheduled for June 22, 2010.

LINES OF INQUIRY

SAFETY BASIS DOCUMENTATION – *The safety basis documentation supporting STP Phase 1 conceptual design is sufficiently conservative and bounding to be relied upon for the next phase of the project.*

ID #	Performance Objectives and Criteria[1]	Met?
SD	***Safety Design Strategy (SDS) & General Requirements***	
SD-1	**Does the SDS include the key elements required by DOE-STD-1189-2008?**	
	1. Does the SDS describe or define the Safety-in-Design approach and philosophies?	
	2. Does the SDS define the criteria or approach to safety functional classification, including evaluation guidelines for both radiological and toxicological hazards and for public and worker protection?	
	3. Does the SDS identify the safety criteria to be applied to the project (commitment to DOE G 420.1-1; DOE O 420.1B, etc)?	
	4. Does the SDS provide a logical discussion of the major hazards involved in the project and the possible consequences those hazards may pose?	
	5. Is the hazard identification based on the initial or assumed hazard inventories?	
	6. Does the SDS discuss key safety decisions that potentially result in significant cost or have resulted in costly rework in past projects?	
	7. Are the following topics explicitly addressed in the SDS and the strategy justified consistent with the hazard categorization and any associated consequence estimates	
	• Seismic and other natural phenomena	
	• Confinement strategy	
	• Fire prevention and mitigation strategy	
	• Anticipated safety functions?	
	8. Does the SDS identify the 10 CFR 830 Subpart B safe harbor methodologies that will ultimately authorize operations (e.g., DOE-STD-3009, Transportation Safety Document/DOE Order 460, etc.) and describe the interfaces with all affected existing facilities' safety basis documents?	
	9. Are the assumptions supporting the DOE-STD-1189 major modification decision for the storage of sludge at T Plant to be authorized via the Unreviewed Safety Question Determination or safety basis amendment processes reasonable and is the documentation supporting the analysis adequate to support the decision?	
	10. Are the assumptions supporting the DOE-STD-1189 major modification decision for those proposed activities related to EC/ST Phase 1 to be authorized at the KW Basin or the planned Knockout Pot activities at KW Basin, Cold Vacuum Drying Facility, and the Canister Storage Building via the Unreviewed Safety Question Determination or safety basis amendment processes reasonable and is the documentation supporting the analysis adequate to support the decision?	
	• Are the proposed activities and physical modifications associated with the EC/ST Phase 1 clearly identified for coverage under the Conceptual Safety Design Report (CSDR) vs. those activities in the KW Basin that are being authorized via the K-Basin Final Safety Analysis Report, with appropriate consideration of the interfaces in applicable safety basis documents?	

ID #	Performance Objectives and Criteria[1]	Met?
	11. Were the appropriate oversight organizations (e.g., DOE Environmental Management; DOE Health, Safety & Security; DOE Chief of Nuclear Safety; Defense Nuclear Facility Safety Board) provided the SDS and were their comments or concerns, if any, adequately resolved or have a disposition path formally included in project planning?	
SD-2	**Does the SDS meet the format and guidance criteria in DOE-STD-1189-2008, Appendix E?**	
	1. Does the SDS include a "Purpose" section that addresses the format and content requirements of DOE-STD-1189-2008 Appendix E?	
	2. Does the SDS include a "Description of Project/Modification" section that addresses the format and content requirements of DOE-STD- 1189-2008 Appendix E?	
	3. Does the SDS include a "Safety Strategy" section that addresses the format and content requirements of DOE-STD-1189-2008 Appendix E?	
	4. Does the SDS include a "Risks to Project Safety Decisions" section that addresses the format and content requirements of DOE-STD- 1189-2008 Appendix E?	
	5. Does the SDS include a "Safety Analysis Approach and Plan" section that addresses the format and content requirements of DOE-STD-1189-2008 Appendix E?	
	6. Does the SDS include a "SDIT- Interfaces and Integration" section that addresses the format and content requirements of DOE-STD- 1189-2008 Appendix E?	
SD-3	**Did the hazard analysis activities in the conceptual design phase address the key elements of DOE-STD-1189-2008 section 3.2?**	
	1. When design requirements are established, are alternatives evaluated to establish a process approach that includes facility and equipment arrangements?	
	2. Have DOE expectations for Safety-in-Design and the Safety Design Guiding Principles and key concepts been applied to ensure that the design requirements and the selection of the preferred processing and facility arrangement alternatives were performed in a way that will result in a safe design?	
	3. Has a safety analyst been involved as part of the evaluation for each of the various alternatives?	
	4. Have the Integrated Project Team (IPT) and the Safety Design Integration Team (SDIT) ensured that the relative hazards, as well as the costs and uncertainties associated with the hazard controls that may be required to address these hazards are considered for each alternative?	
	5. Has the safety work completed for the conceptual design phase accomplished the following:	
	• Document and establish the preliminary inventory of hazardous materials	
	• Establish and document the preliminary hazard categorization of the facility	
	• Identify and analyze primary facility hazards and facility-level design basis accidents	
	• Provide an initial determination, based on the Preliminary Hazards Analysis (PHA), of safety class and safety significant Structures, Systems, and Components (SSCs)?	
	6. Has a Safety-in-Design and Opportunity Assessment been used to evaluate the overall safety design basis risks and opportunities associated with the project?	
	7. Have the following major activities taken place during the conceptual design phase:	
	• The requirements analysis from the pre-conceptual phase has been further developed to include safety functions and SSC requirements and is documented in the Conceptual Design Report (CDR)	
	• Alternative design concepts have been analyzed and a preferred alternative has been selected	

ID #	Performance Objectives and Criteria[1]	Met?
	• A SDS has been developed that meets the requirements listed above	
	• A preliminary hazards analysis (PHA) has been performed to provide the basis for facility preliminary hazard categorization	
	• A preliminary Fire Hazards Analysis (PFHA) has been performed that identifies and assess fire risk and defines levels of Safety-in-Design	
	Does the STP PFHA address the Maximum Allowable Quantity (MAQ) per Control Area for hazardous materials as prescribed by Washington Administrative Code (WAC) 173-303 and the International Fire Code	
	Are the quantities of ignitable and reactive waste developed using a conservative method?	
	Does storing the sludge at T Plant comply with WAC 173-303 MAQ limits?	
	• A preliminary criticality safety evaluation(s) has been performed that identifies and evaluates appropriate base-case scenarios supporting credible normal and abnormal operating conditions developed as required by DOE O420.1B and DOE-STD-3007-2007, (*Guidelines for Preparing Criticality Safety Evaluations at Department of Energy Non-Reactor Nuclear Facilities*).	
	• A facility-level Design Basis Accident (DBA) analysis has been performed to identify the major facility safety functions needed	
	• The SSCs and the safety classifications are proposed for the major safety functions	
	• The initial Safety-in-Design Risk and Opportunities Assessment has been developed	
	• The CDR has been developed to document the final conceptual design	
	• The CSDR has been developed to document the bases for the safety design aspects of the facility	
	• Required technical studies necessary to resolve risks and opportunities have been identified	
	• The initial baseline range estimates have been identified?	
HI	***Hazard Identification & Control Selection***	
HI-1	**Did the hazard analysis activities in the conceptual design phase address the key elements of DOE-STD-1189-2008 section 4.2? When design requirements are established, are alternatives evaluated to establish a process approach that includes facility and equipment arrangements?**	
	1. When design requirements are established, are alternatives evaluated to establish a process approach that includes facility and equipment arrangements?	
	2. Do the hazards identified in the PHA address all of the operations (including startup and shutdown) for both normal operations and upset conditions?	
	- Have the appropriate facility hazards been identified and were the risks from these hazards properly analyzed in the CSDR?	
	3. Are conservative release estimates developed in the analytical calculations, and conservative radiological and toxicological consequence analyses performed consistent with DOE-STD-1189 appendices?	
	- Is the hazard and accident analysis methodology consistent with nuclear safety basis approaches in the DOE Complex, as modified by DOE-STD-1189 guidance or the *Hanford Safety Analysis and Risk Assessment Handbook* methods, as appropriate?	
	4. Were the safety related SSC properly classified using the Exposure Guideline values as directed by DOE STD 1027? [DNFSB 2004-2]	

ID #	Performance Objectives and Criteria[1]	Met?
	5. Do hazards analyses support the preliminary identification of the required safety functions as well as the preliminary set of SSCs?	
	6. Has the hazards analysis been used to support preliminary identification of defense-in-depth or important to safety SSCs to the design staff as appropriate?	
HI-2	**Are controls strategies for DBAs clearly identified in the hazard analysis? Does the DBA control strategy include required safety functions and classifications?**	
	1. Are safety decisions consistent with prevention / mitigation preferences established in the approved SDS?	
	2. Does the DBA control strategy include the SSCs required to perform the identified safety functions?	
	3. Does the DBA control strategy include natural phenomena hazard (NPH) performance categories (non seismic NPH) and seismic design bases for major SSCs?	
	4. Was the hazards analysis process used to arrive at the identified controls based on sound safety principles?	
	5. Were the hazards analysis process and the criteria for selection of safety SSCs appropriately conservative?	
HI-3	**Were the necessary inputs for the completion of the PHA provided and used in the PHA process including:**	
	• Facility site or location selection	
	• General arrangement drawings	
	• Material-at-Risk (MAR) estimates or assumptions and material flow balances	
	- Were conservative MAR values used to determine the safety classification of the operations?	
	• Sizing of major process system containers, tanks, piping and similar items	
	• Process block flow diagrams or equivalent documentation of the required major process flow steps and their sequence	
	• Preliminary one-line diagrams for ventilation, electrical power and distribution, special mechanical handling, instrumentation and control system architecture	
	• Summary process design description and sequence of major operations; and	
	• Confinement strategy?	
	- Are passive and active confinement controls conservatively developed and appropriately implemented [DNFSB 2004-2]? Are any exemptions to the KW ventilation system currently planned?	
HI-4	**Did the hazards analysis performed in the conceptual design phase identify the high cost safety functions and design requirements for the SSCs that will be included in the project, including the following as appropriate:**	
	• Building structure	
	• Building and process confinement	
	• Power systems, including those associated with single failure criteria for safety class SSCs	
	• Fire protection provisions; and	
	• Special mechanical equipment (e.g., glove boxes)?	

ID #	Performance Objectives and Criteria[1]	Met?
HI-5	**Did the PHA establish an appropriate suite of Design Basis Accidents (DBAs) to define functional and performance requirements for the facility design?**	
	- Are all relevant accident scenarios considered in determining the bounding DBAs (including the spectrum of potential accidents and initiators)?	
	1. Did the PHA DBAs include internally initiated events such as:	
	• Fire	
	• Explosion	
	• Loss of containment/confinement	
	• Process upsets	
	• Inadvertent nuclear criticality?	
	2. Did the PHA DBAs include the appropriate externally initiated events?	
	3. Did the PHA DBAs consider the appropriate NPH initiated events?	
HI-6	**Are the hazardous release event evaluations based on facility-level events?**	
HI-7	**For those events with consequences that do not lead to selection of safety class or safety significant controls, does the analysis identify the controls that are appropriate for facility worker, collocated worker, and public defense-in-depth?**	
	• Does the conceptual design incorporate sufficient defense in depth? Are there multiple layers of protection to prevent or mitigate the unintended release of radioactive materials to the environment (e.g., isolation, confinement, successive physical barriers, minimizing MAR, etc.)?	
CR	***Conceptual Safety Design Report (CSDR)***	
CR-1	**Does the CSDR meet the format and guidance criteria in DOE-STD-1189-2008, Appendix H?**	
	1. Does the CSDR include an "Introduction" section that addresses the format and content requirements of DOE-STD-1189-2008 Appendix H including:	
	• Facility Mission Overview, and	
	• Site location?	
	2. Does the CSDR include a chapter on "Conceptual Design Description" that addresses the format and content requirements of DOE-STD-1189-2008 Appendix H including:	
	• Facility Structure and Layout?	
	• Process Description?	
	3. Does the CSDR include a chapter on "Preliminary Hazard Categorization" that addresses the format and content requirements of DOE-STD-1189-2008 Appendix H including:	
	• Hazardous Material Inventories?	
	• Comparison of Inventories to Threshold Quantities?	
	4. Does the CSDR include a chapter on "Design Basis Accidents" that addresses the format and content requirements of DOE-STD-1189-2008 Appendix H:	
	• Facility-Level DBAs?	
	• Unmitigated DBA Analyses?	
	• Preliminary Selection and Classification of Safety SSCs?	

ID #	Performance Objectives and Criteria[1]	Met?
	5. Does the CSDR include a chapter on "Nuclear Safety Design Criteria" that addresses the format and content requirements of DOE-STD- 1189-2008 Appendix H including:	
	• Approach for Compliance with Design Criteria	
	• Exceptions to Design Criteria?	
	• Have the safety design requirements and considerations in DOE O 420.1B been addressed in the design?	
	- Are the classic fire protection safety features that address codes and standards as prescribed in DOE O 420.1B and the Supplemental Contractor Requirements Document (SCRD) incorporated into the conceptual design?	
	- Have ALARA results been input into the conceptual design as prescribed in 10 CFR 835 subpart K?	
	- Is the Annex ventilation and shielding design and are the controls and operational methods for disconnecting lines to the STSC protective of the worker during off-normal and upset conditions	
	- Does the planned operating envelop safely support radiation/contamination controls, maintenance and operation of all components?	
	- Have all radiation protection risks been identified and addressed; do any remain?	
	- Has the design of the STP followed ISM principals for the protection of the workers, public and environment?	
	- Have all material handling risks been identified and addressed; do any remain (e.g., any unmitigated radiological exposures created by material handling)?	
	• Have the appropriate NPH criteria from DOE Order O 420.1B and its guidance documents as modified by DOE-STD-1189 Appendix A been determined and all are addressed in the CSDR?	
	- Are there any known disagreements from oversight organizations regarding the determination of a Seismic Design Category SDC-3 Limit State D?	
	- Are any exemptions associated with backfitting issues for non-seismic NPH DBAs planned at this time?	
	• Have the structural and utilities interfaces between the new KW Basin Annex with the KW structure been adequately considered?	
	- Are any exemptions due to backfitting issues associated with the interfaces planned at this time?	
	6. Does the CSDR include a chapter on "Other Considerations" that addresses the format and content requirements of DOE-STD-1189- 2008 Appendix H including:	
	• Planned Studies and Analyses	
	• Safety-in-Design Risks and Opportunities	
	• Lessons Learned from Previous Experience Involving Major Systems?	
	- Have appropriate lessons learned from the previous KE to KW hose-in-hose transfer project been applied, both from a process design and safety basis perspective?	

ID #	Performance Objectives and Criteria[1]	Met?
	7. Is the DOE RL Conceptual Safety Validation Report (CSVR) being prepared per the conceptual design approval bases from DOE-STD-1104-2009, *Review and Approval of Nuclear Facility Safety Basis and Safety Design Basis Documents*?	
	• Are there issues in the CSDR or PHA that warrant the equivalent of DOE Conditions of Approval (COAs), and will they be formally tracked for closure as soon as practicable, or planned to be closed during the development of the Safety Evaluation Report for the CD-2/CD-3 Preliminary Documented Safety Analysis?	
PR	***Risks to Project Safety Decisions***	
PR-1	**Has the Safety-in-Design Risk and Opportunity Assessment been developed?**	
	1. Does the Safety-in-Design Opportunity Assessment interface with the project risk management plan consistent with the guidance and expectations identified in DOE-STD-1189-2008, Appendix F?	
	2. Have all structural risks been identified and addressed; do any remain? Since the results of the 10-year update required by DOE Order O 420.1B to the Hanford NPH criteria will not be known until 2012 - 2013, has a sufficiently conservative approach been selected in the interim to establish Design Basis NPH criteria (all NPH, not just seismic)?	
	3. At conceptual design, are there any planned exemptions to any codes and standards not identified by the above review criteria?	
	4. At conceptual design, have any equivalencies to applicable EC/ST Phase 1 codes and standards been made by the design authority or the DOE RL approval authority (e.g., RL Manager, RL Authority Having Jurisdiction, etc.)? If so, are levels beyond DOE RL approval planned?	
II	***Safety Design Integration Team – Interfaces and Integration***	
II-1	**Does the Safety Design Integration include the interface organizations and activities identified in Table 7-1 of DOE-STD-1189-2008 as appropriate?**	
II-2	**Do the interfaces include (as appropriate):**	
	• Quality Assurance	
	• Fire Protection	
	• Criticality Safety	
	• Radiological Protection	
	• Human Factors	
	• Security	
	• Environmental Protection	
	• Hazardous Materials	
	• Radiological and Hazardous Waste Management	
	• Emergency Preparedness	
	• External Reviews	
	• System Engineer Program	
	• Procedures, Training and Qualification?	
II-3	**Do these interfaces address the appropriate resource requirements and guidance as identified in Table 7-1?**	

[1] *The site should provide the technical bases and assumptions that support the answers provided to each Line of Inquiry. If possible, the review teams should independently verify the technical bases and assumptions.*

TRANSPORTATION SAFETY– *The transportation safety documentation supporting STP Phase 1 conceptual design is sufficiently conservative and bounding and applicable controls are appropriate to support transporting STP sludge to T Plant.*

ID #	Performance Objectives and Criteria[1]	Met?
TS	***Transportation Safety***	
TS-1	**Is the overall approach (or transportation safety design strategy) to developing and approving the transportation safety basis documents for transferring the sludge to T Plant appropriate for the STP conceptual design?**	
TS-2	**Is the conceptual design for transportation safety based on conservative assumptions and analyses that are consistent with the Criticality Safety Evaluation Report (CSER) for the planned waste packaging?**	
TS-3	**Is the conceptual design for transportation safety based on conservative assumptions and analyses that demonstrate planned shielding will achieve compliance with surface dose rate limits established in the transportation safety basis?**	
TS-4	**Is the conceptual design for transportation safety based on conservative assumptions and analyses that demonstrate expected hydrogen gas and heat generation values will not exceed the gas generation and thermal limits established in the transportation safety basis?**	

[1] The site should provide the technical bases and assumptions that support the answers provided to each Line of Inquiry. If possible, the review teams should independently verify the technical bases and assumptions.

SAFEGUARDS & SECURITY – *The conceptual design is consistent with safeguards and security approvals.*

ID #	Performance Objectives and Criteria[1]	Met?
SS	***Safeguards & Security***	
SS-1	**Does the Phase 1 process as described in the conceptual design incorporate the physical security and control / accountability requirements as specified in the most recent safeguards deviation approved by RL? [Currently – January 8, 2010, 10-SES-0054]**	
SS-2	**Has a preliminary security Vulnerability Assessment been completed during the conceptual design phase and factored into the Preliminary Hazards Analysis?**	
SS-3	**Does the CSDR include a chapter on "Security Hazards and Design Implications" that addresses the format and content requirements of DOE-STD-1189-2008 Appendix H?**	
SS-4	**Have any a preliminary safeguards and security deviations or variances been completed during the conceptual design phase and factored into the PHA?**	

[1] The site should provide the technical bases and assumptions that support the answers provided to each Line of Inquiry. If possible, the review teams should independently verify the technical bases and assumptions.

Enclosure to TIPR Team Charter

TIPR Team Member

Summary Biographies

HERBERT G. SUTTER

Education

A.B. Chemistry, Hamilton College, 1964
Ph.D. Physical Chemistry, Brown University, 1969
Post Doctoral Theoretical Chemistry, Cambridge University, UK, 1970-72

Representative Skills and Experience

Dr. Sutter has more than thirty years experience in the fields of high and low level radioactive waste treatment, separations science, waste water treatment, vitrification, and analytical chemistry. For the past twenty years he has provided technical and programmatic support to DOE's Office of Environmental Management (EM). Dr. Sutter has provided technical assistance to the DOE programs at Hanford, Savannah River, and other sites in: (1) high level waste disposal; (2) vitrification; (3) separation technologies; (4) nuclear waste characterization; (5) technology development); and (6) analytical laboratory management.

From 2007 through the present Dr, Sutter has supported EM's Office of Project Recovery working on technology aspects of Hanford's Waste Treatment Plant. During that time he also helped develop the EM Technology Readiness Assessment (TRA)/Technology Maturation Plan (TMP) Process Guide (March 2008) and led the CD-1 TRA of the Sludge Treatment Project (STP) - Phase 1 Engineered Container/Settler Tube Retrieval and Transfer to T Plant Subproject. From 2005 to 2006, Dr. Sutter assisted EM in the development of a long-term, complex-wide Project Plan for Technology Development and Demonstration. From 2002-2004, as senior scientist for Kenneth T. Lang Associates, Inc. he provided support to EM in several areas including the evaluation of HLW vitrification technologies at Hanford and pretreatment and separation technologies at Savannah River. From 1990-2002, as a scientist for Science Applications International Corporation, he supported EM in the areas of nuclear waste treatment and characterization and analytical chemistry. From 1982-1990, Dr. Sutter was Vice President and Chief Scientist at Duratek Corporation and responsible for technical direction of all Duratek research and development and commercialization programs in ion exchange, filtration and separation techniques. Relevant experience includes: waste water treatment, bench and pilot testing, and waste treatment studies. Dr. Sutter has authored or co-authored over 30 journal articles and technical reports.

DR. NAEEM M. ABDURRAHMAN

Education

PhD Nuclear Engineering and Science, Rensselaer Polytechnic University, 1991
MS Nuclear Engineering, University of Washington, 1985
BS Nuclear Engineering, University of Tennessee, 1978
BS Engineering Physics, University of Tennessee, 1978
MBA Business Administration, Washington State University, 2008

Representative Skills and Experience

Dr. Naeem Abdurrahman joined DOE Office of Waste Processing (EM-31) in June 2009 where he was involved in EM's effort on technology development for DOE's HLW cleanup. Dr. Abdurrahman has also been the lead on EM-31 National Academies of Science activities including an ongoing study on Waste Forms. Dr. Abdurrahman has recently joined EM's Office of Safety Management (EM-21).

Before joining DOE in 2009, Naeem was the Lead Nondestructive Assay (NDA) Scientist for the Hanford Site, first with Fluor Hanford and then with CH2M Hill. He was in charge of the TRU NDA Program as well as the Hanford Site NDA Program. Before joining Fluor Hanford in 2001, Dr. Abdurrahman served on the Faculty of Nuclear and Mechanical Engineering at The University of Texas at Austin, part of which he also served as the Nuclear Engineering Program Coordinator. Dr Abdurrahman has also spent one summer (1999) as a visiting scientist at Argonne National Laboratory.

Dr. Abdurrahman conducted research, mostly with funding from DOE and NSF, in the areas of Nuclear Materials Characterization and Nondestructive Assay, Neutron Imaging and Neutron Computed Tomography, Neutron Spectrometry, Computational Radiation Transport Methods, and Disposition of Weapons Plutonium in Light Water Reactors. Dr. Abdurrahman has authored or co-authored over 40 publications in archival and peer reviewed journals and conference proceedings and has given numerous presentations at national and international technical conferences and meetings.

Dr. Abdurrahman has served on many review and expert panels and committees both at the national and international levels including the American Nuclear Society, the National Science Foundation, US Department of Energy, US Civilian Research and Development Foundation for the Independent Sates of the Former Soviet Union, United States/Russian Technical Specialists Team on Water Reactors for Fissile Materials Disposition, and the Organization for Economic Cooperation and Development/Nuclear Energy Agency Criticality Safety Working Party, and the Hanford Senior Criticality Safety Committee.

Dr. Abdurrahman is an active member of the American Nuclear Society, the Institute of Nuclear Materials Management, and Sigma Xi, The Scientific Research Society. He is also a founding member of the International Society for Neutron Radiography. Dr. Abdurrahman is a licensed professional engineer in the State of Connecticut.[6]

[6] License is currently inactive!

TERRY L. FOPPE

Education

B.S., Aerospace Engineering, Parks College of St. Louis University, 1972
M.S., Safety Management, University of Arizona, 1976
30+ hours towards M.S., Industrial Engineering (Ergonomics/Human Factors Engineering), North Carolina State University, 1977

Representative Skills and Experience

Mr. Foppe has approximately 35 years of professional experience in safety analysis, risk assessments, fire protection engineering, and occupational safety and health. He provided developmental support, or independent review and approval support, to the operating contractors or the U.S. Department of Energy (DOE) field offices and the Office of Nuclear Safety for the past 27 years for safety analysis, hazards and accident analysis, and qualitative or quantitative risk assessments of non-reactor nuclear and hazardous chemical facilities at several DOE sites including the Argonne National Laboratory, Hanford Richland Operations Office and the Office of River Protection, Los Alamos National Laboratory, Rocky Flats, Nevada Test Site, Sandia National Laboratories, and decommissioning of Environmental Management small site projects (Brookhaven National Laboratory, Separations Process Research Unit).

These evaluations were used for development of: (1) authorization basis/safety basis documents such as Documented Safety Analysis (DSA) / Safety Analysis Reports / Basis for Interim Operations for plutonium processing or Transuranic waste handling facilities, hazard classifications of nuclear facilities and activities, safety classifications of structures, systems, and components, Technical Safety Requirements (TSR), Unreviewed Safety Question (USQ) Determinations, and Justifications for Continued Operations; (2) NEPA Environmental Assessments and Environmental Impact Statements; (3) off-site Emergency Planning Hazards Assessments; (4) radiological and chemical sabotage vulnerability assessments; and (5) risk management decision making for natural phenomena structural upgrades or risk acceptance. He also developed and taught safety basis training courses on DSA/TSR, hazard and accident analyses, DOE Handbook 3010 airborne release fractions / respirable fractions, safety basis overview for the DOE Facility Representative training program, and the USQ process. He contributed to authoring the DOE Standard DOE-STD-5506-2007, *Preparation of Safety Basis Documents for Transuranic (TRU) Waste Facilities*. Experience prior to the above included eight years of developing, coordinating, and implementing safety management and fire protection programs for DOE and other commercial companies or clients to protect employees, the public, property, and the environment. He is a Registered Professional Engineer (fire protection engineering) and a Certified Safety Professional (comprehensive practice). Mr. Foppe has published in journals or presented 24 papers at DOE and other conferences on nuclear and chemical safety analyses and risk assessments.

TIM HAYES

Education

MS Chemistry, University of Nebraska – August 1989
BS Chemistry and Physics, New Mexico Institute of Mining and Technology - May 1984

Representative Skills and Experience

Mr. Tim Hayes has over 25 years experience in actinide science with Los Alamos National Laboratory. His career at LANL has given him experience performing and managing technical operations in a nuclear facility. This includes actinide recovery, technology development, nuclear materials disposition and handling, waste management, nuclear material shipping and receiving, nuclear facility safety basis, and nuclear material control and accountability. He held various management positions at LANL in Waste Management, Nuclear Material Management, and Operations Management.

From 2007 to the present Mr. Hayes has been using his experience and background in actinide science to develop technical solutions and long term strategies for the disposition of radioactive waste for the DOE's National Tranuranic Waste Program. From 2005 to 2007 he was a Division Leader in Stockpile Manufacture and Support responsible for technical leadership, operation, quality, and management for the Plutonium Facility and the Detonator Fabrication Facility at Los Alamos National Laboratory. From 2001 to 2005 Mr. Hayes was Group Leader for Nuclear Materials Management with technical responsibilities that included operation and management of nondestructive assay, measurement control and calibration, and nuclear material storage container design, nuclear material use management, nuclear material control and accountability, radioactive material shipping and receiving. From 1999 to 2001 he was Deputy Group Leader of Waste Management and Environmental Compliance for Nuclear Materials Technology Division. His principle duties were shipping and receiving nuclear material, primary point of contact for the DOE NNSA and New Mexico State regulators (NMED) for waste issues at the Plutonium Facility, submission of the Part B permit to the State of New Mexico for the Plutonium Facility, and managing TRU, Low Level, mixed, universal and New Mexico Special waste. From 1989 to 1997 Mr. Hayes led a large team of staff and technicians responsible for the recovery and purification of plutonium and other actinides from low level and scrap material and conversion to oxide or metal feed stock. He served as both as supervisor and technical expert over unit process such as dissolution, ion-exchange, solvent extraction, and oxide to metal conversion. Throughout his career Mr. Hayes has authored a number of technical publications and presentations as well as Process Hazard Analysis documents.

ROBERT T. HYNES

Education

M.S., Environmental Engineering, Washington State University, 2000
M.S., Environmental Science, Washington State University, 1998
B.S., Nuclear Engineering Technology, Thomas Edison State College, 1987

Representative Skills and Experience

Mr. Hynes has over 35 years of related nuclear, environmental, and management experience. His work experience has included Operations, Technical/Engineering, Maintenance, Regulatory, Training, and Waste Management and Transportation experience in the U.S. Navy, commercial nuclear power plants, and Department of Energy (DOE) facilities. The last twelve years have been associated with DOE environmental restoration projects including burial ground remediation/closure and facility characterization, deactivation, demolition, disposal, transportation and end-state closure.

From 2009 to the present, Mr. Hynes has been employed as the Senior Manager Federal Services for WMG, Inc. of Peekskill, NY. WMG provides professional nuclear engineering services and software to government and commercial clients with a demonstrated expertise in the area of radioactive materials management. Mr. Hynes is responsible for providing overall accountability in managing and executing government related projects and services for WMG's Hanford Washington office. Prior to coming to WMG, Mr. Hynes was the Waste Services Manager for Washington Closure Hanford under Hanford's River Corridor Contract. As the Waste Services Manager, Mr. Hynes was responsible for managing the Waste Services Program including waste characterization, designation, management, transportation, waste minimization, and pollution prevention for both reactor burial ground and facility deactivation/demolition projects. From 2002 to 2008, Mr. Hynes was a waste management and transportation Subject Matter Expert for Bechtel Hanford on the Environmental Restoration Contract and Washington Closure Hanford on the River Corridor Contract. Prior to 2002, Mr. Hynes was employed by Parsons, Waste Management, and Fluor Hanford on various Hanford cleanup projects. Between 1981 and 1997, Mr. Hynes, an NRC licensed Senior Reactor Operator, worked in commercial nuclear power plants across the country providing technical, engineering, and operational services. Mr. Hynes served the U.S. Navy from 1972 to 1981 as a nuclear electronics technician on two submarines and an instructor at a nuclear power prototype.

Appendix C Team Resumes

NAEEM ABDURRAHMAN

Education

PhD Nuclear Engineering and Science, Rensselaer Polytechnic University, 1991
MS Nuclear Engineering, University of Washington, 1985
BS Nuclear Engineering, University of Tennessee, 1978
BS Engineering Physics, University of Tennessee, 1978
MBA Business Administration, Washington State University, 2008

Representative Skills and Experience

Dr. Naeem Abdurrahman joined DOE Office of Waste Processing (EM-31) in June 2009 where he was involved in EM's effort on technology development for DOE's HLW cleanup. Dr. Abdurrahman has also been the lead on EM-31 National Academies of Science activities including an ongoing study on Waste Forms. Dr. Abdurrahman has recently joined EM's Office of Safety Management (EM-21).
.
Before joining DOE in 2009, Naeem was the Lead Nondestructive Assay (NDA) Scientist for the Hanford Site, first with Fluor Hanford and then with CH2M Hill. He was in charge of the TRU NDA Program as well as the Hanford Site NDA Program. Before joining Fluor Hanford in 2001, Dr. Abdurrahman served on the Faculty of Nuclear and Mechanical Engineering at The University of Texas at Austin, part of which he also served as the Nuclear Engineering Program Coordinator. Dr Abdurrahman has also spent one summer (1999) as a visiting scientist at Argonne National Laboratory.

Dr. Abdurrahman conducted research, mostly with funding from DOE and NSF, in the areas of Nuclear Materials Characterization and Nondestructive Assay, Neutron Imaging and Neutron Computed Tomography, Neutron Spectrometry, Computational Radiation Transport Methods, and Disposition of Weapons Plutonium in Light Water Reactors. Dr. Abdurrahman has authored or co-authored over 40 publications in archival and peer reviewed journals and conference proceedings and has given numerous presentations at national and international technical conferences and meetings.

Dr. Abdurrahman has served on many review and expert panels and committees both at the national and international levels including the American Nuclear Society, the National Science Foundation, US Department of Energy, US Civilian Research and Development Foundation for the Independent Sates of the Former Soviet Union, United States/Russian Technical Specialists Team on Water Reactors for Fissile Materials Disposition, and the Organization for Economic Cooperation and Development/Nuclear Energy Agency Criticality Safety Working Party, and the Hanford Senior Criticality Safety Committee.

Dr. Abdurrahman is an active member of the American Nuclear Society, the Institute of Nuclear Materials Management, and Sigma Xi, The Scientific Research Society. He is also a founding member of the International Society for Neutron Radiography. Dr. Abdurrahman is a licensed professional engineer in the State of Connecticut.[1]

[1] License is currently inactive.

TERRY L. FOPPE

Education

B.S., Aerospace Engineering, Parks College of St. Louis University, 1972
M.S., Safety Management, University of Arizona, 1976
30+ hours towards M.S., Industrial Engineering (Ergonomics/Human Factors Engineering), North Carolina State University, 1977

Representative Skills and Experience

Mr. Foppe has approximately 35 years of professional experience in safety analysis, risk assessments, fire protection engineering, and occupational safety and health. He provided developmental support, or independent review and approval support, to the operating contractors or the U.S. Department of Energy (DOE) field offices and the Office of Nuclear Safety for the past 27 years for safety analysis, hazards and accident analysis, and qualitative or quantitative risk assessments of non-reactor nuclear and hazardous chemical facilities at several DOE sites including the Argonne National Laboratory, Hanford Richland Operations Office and the Office of River Protection, Los Alamos National Laboratory, Rocky Flats, Nevada Test Site, Sandia National Laboratories, and decommissioning of Environmental Management small site projects (Brookhaven National Laboratory, Separations Process Research Unit).

These evaluations were used for development of: (1) authorization basis/safety basis documents such as Documented Safety Analysis (DSA) / Safety Analysis Reports / Basis for Interim Operations for plutonium processing or Transuranic waste handling facilities, hazard classifications of nuclear facilities and activities, safety classifications of structures, systems, and components, Technical Safety Requirements (TSR), Unreviewed Safety Question (USQ) Determinations, and Justifications for Continued Operations; (2) NEPA Environmental Assessments and Environmental Impact Statements; (3) off-site Emergency Planning Hazards Assessments; (4) radiological and chemical sabotage vulnerability assessments; and (5) risk management decision making for natural phenomena structural upgrades or risk acceptance. He also developed and taught safety basis training courses on DSA/TSR, hazard and accident analyses, DOE Handbook 3010 airborne release fractions / respirable fractions, safety basis overview for the DOE Facility Representative training program, and the USQ process. He contributed to authoring the DOE Standard DOE-STD-5506-2007, *Preparation of Safety Basis Documents for Transuranic (TRU) Waste Facilities.* Experience prior to the above included eight years of developing, coordinating, and implementing safety management and fire protection programs for DOE and other commercial companies or clients to protect employees, the public, property, and the environment. He is a Registered Professional Engineer (fire protection engineering) and a Certified Safety Professional (comprehensive practice). Mr. Foppe has published in journals or presented 24 papers at DOE and other conferences on nuclear and chemical safety analyses and risk assessments.

TIM HAYES

Education

MS Chemistry	University of Nebraska – August 1989
BS Chemistry and Physics	New Mexico Institute of Mining and Technology - May 1984

Representative Skills and Experience

Mr. Tim Hayes has over 25 years experience in actinide science with Los Alamos National Laboratory. His career at LANL has given him experience performing and managing technical operations in a nuclear facility. This includes actinide recovery, technology development, nuclear materials disposition and handling, waste management, nuclear material shipping and receiving, nuclear facility safety basis, and nuclear material control and accountability. He held various management positions at LANL in Waste Management, Nuclear Material Management, and Operations Management.

From 2007 to the present Mr. Hayes has been using his experience and background in actinide science to develop technical solutions and long term strategies for the disposition of radioactive waste for the DOE's National Tranuranic Waste Program. From 2005 to 2007 he was a Division Leader in Stockpile Manufacture and Support responsible for technical leadership, operation, quality, and management for the Plutonium Facility and the Detonator Fabrication Facility at Los Alamos National Laboratory. From 2001 to 2005 Mr. Hayes was Group Leader for Nuclear Materials Management with technical responsibilities that included operation and management of nondestructive assay, measurement control and calibration, and nuclear material storage container design, nuclear material use management, nuclear material control and accountability, radioactive material shipping and receiving. From 1999 to 2001 he was Deputy Group Leader of Waste Management and Environmental Compliance for Nuclear Materials Technology Division. His principle duties were shipping and receiving nuclear material, primary point of contact for the DOE NNSA and New Mexico State regulators (NMED) for waste issues at the Plutonium Facility, submission of the Part B permit to the State of New Mexico for the Plutonium Facility, and managing TRU, Low Level, mixed, universal and New Mexico Special waste. From 1989 to 1997 Mr. Hayes led a large team of staff and technicians responsible for the recovery and purification of plutonium and other actinides from low level and scrap material and conversion to oxide or metal feed stock. He served as both as supervisor and technical expert over unit process such as dissolution, ion-exchange, solvent extraction, and oxide to metal conversion. Throughout his career Mr. Hayes has authored a number of technical publications and presentations as well as Process Hazard Analysis documents.

ROBERT T. HYNES

Education

M.S., Environmental Engineering, Washington State University, 2000
M.S., Environmental Science, Washington State University, 1998
B.S., Nuclear Engineering Technology, Thomas Edison State College, 1987

Representative Skills and Experience

Mr. Hynes has over 35 years of related nuclear, environmental, and management experience. His work experience has included Operations, Technical/Engineering, Maintenance, Regulatory, Training, and Waste Management and Transportation experience in the U.S. Navy, commercial nuclear power plants, and Department of Energy (DOE) facilities. The last twelve years have been associated with DOE environmental restoration projects including burial ground remediation/closure and facility characterization, deactivation, demolition, disposal, transportation and end-state closure.

From 2009 to the present, Mr. Hynes has been employed as the Senior Manager Federal Services for WMG, Inc. of Peekskill, NY. WMG provides professional nuclear engineering services and software to government and commercial clients with a demonstrated expertise in the area of radioactive materials management. Mr. Hynes is responsible for providing overall accountability in managing and executing government related projects and services for WMG's Hanford Washington office. Prior to coming to WMG, Mr. Hynes was the Waste Services Manager for Washington Closure Hanford under Hanford's River Corridor Contract. As the Waste Services Manager, Mr. Hynes was responsible for managing the Waste Services Program including waste characterization, designation, management, transportation, waste minimization, and pollution prevention for both reactor burial ground and facility deactivation/demolition projects. From 2002 to 2008, Mr. Hynes was a waste management and transportation Subject Matter Expert for Bechtel Hanford on the Environmental Restoration Contract and Washington Closure Hanford on the River Corridor Contract. Prior to 2002, Mr. Hynes was employed by Parsons, Waste Management, and Fluor Hanford on various Hanford cleanup projects. Between 1981 and 1997, Mr. Hynes, an NRC licensed Senior Reactor Operator, worked in commercial nuclear power plants across the country providing technical, engineering, and operational services. Mr. Hynes served the U.S. Navy from 1972 to 1981 as a nuclear electronics technician on two submarines and an instructor at a nuclear power prototype.

HERBERT G. SUTTER

Education

A.B. Chemistry, Hamilton College, 1964
Ph.D. Physical Chemistry, Brown University, 1969
Post Doctoral Theoretical Chemistry, Cambridge University, UK, 1970-72

Representative Skills and Experience

Dr. Sutter has more than thirty years experience in the fields of high and low level radioactive waste treatment, separations science, waste water treatment, vitrification, and analytical chemistry. For the past twenty years he has provided technical and programmatic support to DOE's Office of Environmental Management (EM). Dr. Sutter has provided technical assistance to the DOE programs at Hanford, Savannah River, and other sites in: (1) high level waste disposal; (2) vitrification; (3) separation technologies; (4) nuclear waste characterization; (5) technology development); and (6) analytical laboratory management.

From 2007 through the present Dr, Sutter has supported EM's Office of Project Recovery working on technology aspects of Hanford's Waste Treatment Plant. During that time he also helped develop the EM Technology Readiness Assessment (TRA)/Technology Maturation Plan (TMP) Process Guide (March 2008) and led the CD-1 TRA of the Sludge Treatment Project (STP) - Phase 1 Engineered Container/Settler Tube Retrieval and Transfer to T Plant Subproject. From 2005 to 2006, Dr. Sutter assisted EM in the development of a long-term, complex-wide Project Plan for Technology Development and Demonstration. From 2002-2004, as senior scientist for Kenneth T. Lang Associates, Inc. he provided support to EM in several areas including the evaluation of HLW vitrification technologies at Hanford and pretreatment and separation technologies at Savannah River. From 1990-2002, as a scientist for Science Applications International Corporation, he supported EM in the areas of nuclear waste treatment and characterization and analytical chemistry. From 1982-1990, Dr. Sutter was Vice President and Chief Scientist at Duratek Corporation and responsible for technical direction of all Duratek research and development and commercialization programs in ion exchange, filtration and separation techniques. Relevant experience includes: waste water treatment, bench and pilot testing, and waste treatment studies. Dr. Sutter has authored or co-authored over 30 journal articles and technical reports.