Spent Nuclear Fuel Alternative Technology Risk Assessment

by

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LIST OF ACRONYMS

ANL	Argonne National Laboratory
CFR	Code of Federal Regulations
DE	Design Engineering
DOE	Department of Energy
DOE-RW	Department of Energy, Office of Civilian Radioactive Waste Management
DWPF	Defense Waste Processing Facility
EBR	Experimental Breeder Reactor
HA	Handling Action
HEU	High Enriched Uranium
HLW	High Level Waste
LEU	Low Enriched Uranium
LLW	Low Level Waste
MGDS	Mined Geologic Disposal System
MTR	Materials & Test Reactor
NWPA	Nuclear Waste Policy Act
PE&CD	Projects, Engineering & Construction Division
R&D	Research & Development
RAPP	Risk Assessment Program Plan
ROD	Record of Decision
RRTT	Research Reactor (Spent Nuclear Fuel) Task Team
SE	Systems Engineering
SFSD	Spent Fuel Storage Division
SNF	Spent Nuclear Fuel
SRS	Savannah River Site
SRTC	Savannah River Technology Center
TBD	To Be Determined
TSS	Transfer and Storage Services
U-Al	Uranium-Aluminum
WAC	(Mined Geologic Disposal System) Waste Acceptance Criteria
WBS	Work Breakdown Structure
WSRC	Westinghouse Savannah River Company

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EXECUTIVE SUMMARY

A Research Reactor Spent Nuclear Fuel Task Team (RRTT) was chartered by the Department of Energy (DOE) Office of Spent Fuel Management with the responsibility to recommend a course of action leading to a final technology selection for the interim management and ultimate disposition of the foreign and domestic aluminum-based research reactor spent nuclear fuel (SNF) under DOE's jurisdiction. The RRTT evaluated eleven potential SNF management technologies and recommended that two technologies, Direct Co-Disposal and an isotopic dilution alternative, either Press & Dilute or Melt & Dilute, be developed in parallel¹.

Based upon that recommendation, the Westinghouse Savannah River Company (WSRC), Spent Fuel Storage Division (SFSD), organized the SNF Alternative Technology Program to further develop the Direct Co-Disposal and Melt & Dilute technologies and ultimately provide a WSRC recommendation to DOE for a preferred SNF alternative management technology. A technology risk assessment was conducted as a first step in this recommendation process to determine if either, or both, of the technologies posed significant risks that would make them unsuitable for further development. This report provides the results of that technology risk assessment.

The risk assessment process involved the completion of the following three activities in accordance with the requirements of the *Risk Assessment Program Plan, Transfer and Storage Services for Aluminum-Based Spent Nuclear Fuel*²:

1. Risk Identification - Identifying the risks for each SNF technology, for each Work Breakdown Structure (WBS) element;
2. Risk Analysis - Evaluating the identified risks (probability and consequences) and assessing them as *High*, *Moderate*, or *Low*; and,
3. Risk Handling Recommendation - Selecting a handling action for each risk (*Mitigate*, *Avoid*, *Transfer*, or *Accept*), and for a handling action of *Mitigate*, determining a mitigation strategy for each identified *High* and *Moderate* risk.

The SNF Alternative Technology Risk Assessment identified 24 active risks^a, of which only 5 were assessed as *Moderate* and 7 were assessed as *High*. All of the *Moderate* and two of the *High* risks were reduced to *Low* risks with success probabilities of 75% or greater, and 3 *High* risks were reduced to *Moderate* risks with success probabilities of 100% using mitigation strategies recommended by the assessment team. The remaining 2 *High* risks (one for each technology) address the possibility of existing repository-level performance requirements being redefined and imposed at the SNF disposal-form-level by the Department of Energy, Office of Civilian Radioactive Waste Management (DOE-RW). While these risks were judged by the assessment team to be *Very Unlikely*, the potential impact of changes in repository requirements will be mitigated by SFSD's continuing dialog with DOE-RW and its Yucca Mountain repository managing and operating contractor.

Based upon the results of this assessment, it is the conclusion of the risk assessment team that the Melt & Dilute and Direct Co-Disposal alternative technologies are both acceptable for further development provided mitigation strategies recommended by the team for *Moderate* and *High* risks are followed and tracked through completion by a project team. SFSD has committed to proceed with the risk management process throughout implementation of the Treatment and Storage Facility Project.

^a See Table 1 on Pages 13 & 14.

INTRODUCTION

BACKGROUND

The Record of Decision for the Environmental Impact Statement on the Proposed Nuclear Weapons Nonproliferation Policy Concerning Foreign Research Reactor Spent Nuclear Fuel directed the Department of Energy (DOE) to implement alternative treatment and packaging technologies that could be utilized in place of conventional processing to achieve safe and cost effective interim storage and ultimate disposal of aluminum-based spent nuclear fuel (SNF). As a result, the DOE Office of Spent Fuel Management chartered the Research Reactor Spent Nuclear Fuel Task Team (RRTT) with the responsibility to recommend a course of action leading to a final technology selection for the interim management and ultimate disposition of the foreign and domestic aluminum-based research reactor SNF under DOE's jurisdiction.

The RRTT evaluated eleven potential SNF management technologies, ranging from direct disposal and isotopic dilution to advanced treatments such as plasma arc treatment and glass material oxidation and dissolution. Using a modified Kepner-Tregoe³ evaluation process, the RRTT recommended that two technologies, Direct Co-Disposal and an isotopic dilution alternative, either Press & Dilute or Melt & Dilute, be developed in parallel. The RRTT also recommended that an advanced technology, Electrometallurgy, although not directly developed for aluminum research SNF nor funded by the SNF program, be considered as a secondary and diverse backup.

Based on the recommendations of the RRTT report¹, WSRC organized the SNF Alternative Technology Program to further develop the Direct Co-Disposal and Melt & Dilute technologies^b and ultimately provide a WSRC recommendation to DOE for a preferred SNF alternative management technology. As a first step in this recommendation process, a technology risk assessment was conducted to determine if either, or both, of the technologies posed significant risks that would make them unsuitable for further development. This report provides the results of the technology risk assessment conducted in accordance with the requirements of the *Risk Assessment Program Plan, Transfer and Storage Services for Aluminum-Based Spent Nuclear Fuel*².

TECHNOLOGY ALTERNATIVES

As noted above, only two technologies, Direct Co-Disposal and Melt & Dilute, were considered in this risk assessment. A brief description of each of these technologies is provided below. Pre-conceptual design has been completed on both technologies^c.

Direct Co-Disposal (see Figure 1 on page 3^c)

In this technology, the SNF will be packaged intact in a canister that has a diameter of approximately seventeen inches and a length of approximately 120 inches. The canister of fuel will be vacuum dried and back-filled with helium. The fuel will be separated in the canister with a basket containing neutron absorber materials. Three to four baskets will be stacked within each canister. After the canister is back-filled and sealed, it will be temporarily stored at the Savannah River Site (SRS) in horizontal concrete storage modules.

^b Press & Dilute was not considered further because it was as costly as Melt & Dilute and did not offer the isotopic dilution capabilities of Melt & Dilute.

^c Figure 8.5.2-1 from the Pre-conceptual Design Report⁴ reprinted here for information only.

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Figure 1. Facility Process Flow Diagram, Direct Co-Disposal

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Ultimately, the canisters will be shipped to a federal Mined Geologic Disposal System (MGDS) repository for final disposal. There each of the SNF canisters will be placed inside a larger waste package containing five Defense Waste Processing Facility (DWPF) high level waste (HLW) canisters before being emplaced in the repository.

The Direct Co-Disposal alternative will require a separate powder metallurgy process to accommodate the disposition of the foreign research reactor target oxide materials listed in Table 5.2-2 of the RRTT report¹. These materials could be combined at 30 wt% with aluminum powder (or higher if necessary to make a good compact), compressed to make 3" OD X 24" slugs, cold welded, loaded into the standard canister, filled with inert gas, welded, leak checked, and finally, interim-stored prior to shipment to the repository.

Melt & Dilute (see Figure 2 on page 5^d)

In this technology, the SNF will be melted in a furnace, and depleted uranium and aluminum (as needed to control the metallurgy and process temperature) will be added to the melt in order to reduce the ²³⁵U enrichment to below 20%, the level required to be treated as low enriched uranium (LEU). If required, neutron absorber materials will also be added to the melt to minimize the potential for long-term criticality in the repository. The melt will be solidified and placed in a steel canister similar to that for the Direct Co-Disposal alternative. Several ingots may be stacked in each canister. The canister will then be back-filled with helium, sealed, and temporarily stored at SRS in horizontal concrete storage modules. Even though additional mass will be added to the disposal form during the melting process (in the form of aluminum and depleted uranium), the total volume required for the disposal forms will only be approximately one quarter of that required for Direct Co-Disposal. Like the Direct Co-Disposal alternative, the canisters will ultimately be shipped to a federal MGDS repository for final disposal with DWPF canisters.

The melting process will cause volatilization of some fission products. Those gases will be collected and processed onsite as either HLW or low level waste (LLW), with the exception of noble gases such as krypton which will be released to the facility stack.

^d Figure 8.6.2-1 from the Pre-conceptual Design Report⁴ reprinted here for information only.

SNF Alternative Technology Risk Assessment

Figure 2. Facility Process Flow Diagram, Melt & Dilute

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TEAM MEMBERS

As directed by the SNF Risk Assessment Program Plan (RAPP)², the following team comprised of individuals from Spent Fuel Storage Division (SFSD), Savannah River Technology Center (SRTC), Project, Engineering & Construction Division/Design Engineering (PE&CD/DE), and Project, Engineering & Construction Division/Systems Engineering (PE&CD/SE), was convened to conduct the risk assessment.

Name	Division	Organization
T. M. Adams	SRTC	Materials Application & Corrosion Technology
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J. M. Carter	PE&CD	Systems Engineering
J. Hurd	PE&CD	Design Engineering
L. T. Lamm	PE&CD	Design Engineering
L. W. Patrick	PE&CD	Systems Engineering
H. B. Peacock, Jr.	SRTC	Materials Application & Corrosion Technology
V. F. Perella	PE&CD	Systems Engineering
F. C. Rhode	SFSD	Spent Fuel Storage Engineering
W. F. Swift	SFSD	Spent Fuel Storage Engineering
D. W. Vinson	SRTC	Materials Technology
E. W. Zimmerman	PE&CD	Systems Engineering

DISCUSSION

INITIATION OF TASK

In a series of five interactive meetings from 11/10/97 to 12/9/97, the team conducted a risk assessment for each of the two selected SNF technologies (Direct Co-Disposal and Melt & Dilute) using the process identified in Section 3.0 of the SNF RAPP. Since this assessment was to include all project risks, the following eight facets of risk as listed in the RAPP were addressed in this assessment to the extent possible:

- Safety
- Environmental
- Technical Performance
- Logistics Support
- Disposition
- Programmatic
- Cost
- Schedule

As noted in the RAPP, the assessment process followed the method of E7 Manual Procedure 2.16, *Technical Risk Analysis*⁵, with one exception. This exception involved the grading of risks as *Low*, *Moderate*, or *High* using a 3 X 3 probability versus consequence matrix, shown in Figure 3. The E7

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Manual Procedure 2.16 prescribes the use of a risk factor equation that can result in many risks considered *Low* and *Moderate* by the risk assessment team falling into the *High* grade. The risk grading process used in this assessment emulates that of the technical community⁶. The use of a matrix in grading risks is also one of the recommended methods in the *Project Risk Analysis Guide*⁷ which is referenced by E11 Manual Procedure 2.62, *Project Risk Analysis*⁸.

PROBABILITY of RISK MATERIALIZING	LIKELY	MODERATE RISK	HIGH RISK	HIGH RISK
	UNLIKELY	LOW RISK	MODERATE RISK	HIGH RISK
	VERY UNLIKELY	LOW RISK	MODERATE RISK	HIGH RISK
		NEGLIGIBLE	MARGINAL	CRITICAL
		SEVERITY of CONSEQUENCE		

Figure 3. Risk Grades

The process used in this risk assessment involved the completion of the following three activities:

1. Risk Identification - Identifying the risks for each SNF technology, for each Work Breakdown Structure (WBS) element;
2. Risk Analysis - Evaluating the identified risks (probability and consequences) and assessing them as *High*, *Moderate*, or *Low*; and,
3. Risk Handling Recommendation - Selecting a handling action for each risk (*Mitigate*, *Avoid*, *Transfer*, or *Accept*), and for a handling action of *Mitigate*, determining a mitigation strategy for each identified *High* and *Moderate* risk.

⁶ The 3 X 3 matrix is based upon a simplification of risk management categories shown in Figure 6.11 of *Systems Engineering* by Andrew P. Sage⁶.

RISK IDENTIFICATION

To facilitate the identification of risks, separate WBS trees were created for each of the subject areas: Manufacturing Facility (or process) and Disposal Form (or product). The WBS tree for each subject area was comprised of functional areas that supported the specific subject area. For the Manufacturing Facility WBS tree (Figure 4), the X.1 Common Facilities functional areas were derived from Section 4.2 of the Transfer and Storage Services Pre-conceptual Design report⁴, and the X.2 Process Facilities functional areas were derived from Sections 4.3 and 4.4 of that same report. Functional areas Y.1.1 through Y.1.5 of the Disposal Form WBS tree (Figure 5) concentrated on canister design issues, while the remaining functional areas (Y.1.6 through Y.1.12) focused on disposal form issues deemed important by the team.

Figure 4. WBS Tree for Manufacturing Facility

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The team used each of the WBS trees to assist in the identification and documentation of risks for each of the functional areas, as appropriate. Candidate risks for each of the subject areas were identified by the team based upon the following:

- Review of technology reports and documents to identify the known risks and inconsistencies;
- Review and analysis of assumptions made for the two SNF technologies during the down-select process;
- Review of assumption, uncertainties, and problems found in technology development and engineering development programs;
- Review of simulations, models, and other studies/analyses for the two SNF technologies; and,
- Review of DOE risk identifiers for applicability to the two SNF technologies.

Documents utilized in the assessment process¹ are listed in the References beginning on Page 15.

Figure 5. WBS Tree for Disposal Form

¹ References 1, 4, 9, and 11 through 18.

A SNF Risk Assessment database⁹ was created using guidelines provided in the RAPP to document each of the risks identified by the team. For each identified risk, the team provided the following initial information.

1. Statement of Risk – A brief, concise statement of the risk, indicating which WBS element or elements were vulnerable and the nature of the vulnerability.
2. Rational Basis for Risk – A brief rationale that makes clear what the impact will be if the risk materializes. This rationale was based upon either best engineering judgement or the results of technical analysis, if available.

RISK ANALYSIS

The team assigned a probability of occurrence and a severity of consequence grade for each of the identified risks documented in the database. These estimates of probability and consequence grades were also based upon either best engineering judgement or technical analysis results, if available, and utilized the following definitions.

1. Probability of Risk Materializing - The probability grade was designated to be *Very Unlikely*, *Unlikely*, or *Likely* as defined below.

Very Unlikely - Not expected to occur anytime in the life cycle of the project or its operating facilities. Estimated recurrence interval exceeds 10,000 years.

Unlikely - Not expected to occur in the life cycle of the project, and doubtful occurrence for its operating facilities. Estimated recurrence interval is 100 to 10,000 years.

Likely - Expected to occur sometime during the life cycle of the project or its operating facilities. Estimated recurrence interval is less than 100 years.

2. Severity of Consequence - The consequence grade was designated to be *Negligible*, *Marginal*, or *Critical* as defined below.

Negligible - Minor threat to cost, schedule, technical performance, environment or people. May require facility minor changes in operations or maintenance, with lost time extending to a few weeks but not months. May involve routine cleanup or first aid, but no redesign.

Marginal - Nominal threat to cost, schedule, technical performance, environment or people. May require minor redesign or repair or environmental remediation with an impact of more than 5% but less than 10% of project schedule and/or life cycle cost. Has potential for minor occupational injury requiring medical intervention.

Critical - Serious threat to cost, schedule, technical performance, environment or people. May prevent completing portions of the mission or cause failure to perform functions to meet requirements. May require major facility redesign or rebuilding, extensive environmental remediation or intensive medical care for life-threatening injury. Impacts will likely exceed 10% of project schedule and/or life cycle cost.

With probability and consequence grades defined, the team used the 3 X 3 probability versus consequence matrix shown in Figure 3 to assign a risk grade to each of the identified risks.

⁹ See Appendix A.

RISK HANDLING RECOMMENDATION

According to the RAPP, each unacceptable risk^a must have a recommended handling action (HA) to make it acceptable. Consequently, the *Moderate* and *High* grade risks were evaluated against each of the following four possible strategies for risk handling before selecting the preferred strategy.

1. Mitigate the Risk - The project can use simulations (virtual prototypes), analytical models or research and development to test-validate assumptions or reduce uncertainties that underpin a risk.
2. Avoid the Risk - The project can simply avoid the risk by choosing another design or another technology or both, whichever is causing the risk.
3. Transfer the Risk - The project can transfer the risk to another of its WBS element or, in some unusual cases, transfer it to an insurance company. Insured risks were not a consideration for the SNF risk assessment.
4. Accept the Risk - The project can accept the risk and do nothing else except to monitor for early triggers or indicators that the risk will strike the project. Upon detecting a trigger, the project will take preplanned evasive action.

Risk handling strategies were selected by the team for each of the *Moderate* and *High* grade risks and documented in the database. Each of the handling action recommendations were to include:

- The basis for the recommendation;
- A rough estimate of the cost, schedule, facilities and manpower needed to accomplish the handling action;
- An estimate of the grade of the risk after the recommended handling action is complete (e.g., the reduction in risk resulting from the handling action);
- Closure criteria, making clear what results must be accomplished for success;
- The probability of success for the handling action.

ASSUMPTIONS

The team used the following general assumptions in conducting the risk assessment.

1. All aluminum-clad SNF types and materials listed in Table 5.2-1 of the Research Reactor SNF Task Team Report¹ will be processed in the SRS canyons as recommended, and consequently, they were not considered in the technology risk assessment.
2. Target materials in powdered form to be received under FRR EIS (Canada, Belgium, Argentina, and Indonesia) listed in Table 5.2-2 of the Research Reactor SNF Task Team Report¹ will be processed in the new Transfer and Storage Services (TSS) facility at SRS and were therefore included in the technology risk assessment.
3. Criterion 2.1.1 of the MGDS Waste Acceptance Criteria (WAC)⁹ requires compliance with the Nuclear Waste Policy Act (NWPA) 'legal' definition of SNF - namely, "fuel that has been withdrawn from a nuclear reactor following irradiation, the constituent elements of which have not been separated by reprocessing."¹⁰ For the purposes of this risk assessment, it is assumed that the

^a Section 2.1 of the RAPP categorizes *Moderate* and *High* grade risks as unacceptable.

Melt & Dilute disposal form meets the intent of this definition (i.e. - treating the SNF to reduce enrichment and achieve the desired metallurgy is not considered to be reprocessing.)

FINDINGS

During the initial assessments, the team identified a total of 33 risks¹, 21 for Melt & Dilute and 12 for Direct Co-Disposal. Nine of those risks¹ were later deemed by the team to be non-credible and were consequently eliminated from further consideration. Justifications for the elimination of these risks are found on the individual database records. An assessment summary for the remaining 24 active risks (14 Melt & Dilute, 10 Direct Co-Disposal) may be found in Table 1 on Pages 13 & 14.

Of the 24 active risks, there were 12 *Low* risks (9 Melt & Dilute / 3 Direct Co-Disposal), 5 *Moderate* risks (3 Melt & Dilute / 2 Direct Co-Disposal), and 7 *High* risks (2 Melt & Dilute / 5 Direct Co-Disposal). The handling action selected by the team for all of the *Low* risks was *Accept*, as recommended by the RAPP, and no additional action was required. All of the *Moderate* risks were assigned a handling action of *Mitigate*, and based upon strategies identified in the database, all of those risks were reduced to *Low* with success probabilities that ranged from 95% to 100%.

For the seven *High* risks, the team selected handling actions of *Mitigate* for five of the risks and *Transfer* for the other two². Of the five *High* risks with mitigating handling actions, two were reduced to *Low* with success probabilities of 75% and 85%, and the other three were reduced to *Moderate* with success probabilities of 100%. The remaining 2 *High* risks (one for each technology) address the possibility of existing repository-level performance requirements being redefined and imposed at the SNF disposal-form-level by DOE-RW. While these risks were judged by the assessment team to be *Very Unlikely*, the potential impact of changes in repository requirements will be mitigated by SFSD's continuing dialog with DOE-RW and its Yucca Mountain repository managing and operating contractor.

TECHNICAL RISK MITIGATION STRATEGIES

As noted above, the team recommended mitigation strategies for all *Moderate* and *High* risks except for the two *High* risks that had selected handling actions of *Transfer*. The strategies recommended by the team may be found on Page 2 of each of the appropriate database records. Estimates for handling action³ were not provided in the database as a part of this task but were instead identified as "to be determined" (TBD). The team agreed that completion of these estimates should be deferred as an action item for a future project team with the appropriate resources. In addition, because there were so few *High* and *Moderate* risks, the team did not attempt to rank them or select a Top-10 list as allowed by the RAPP⁴.

¹ Refer to the SNF Risk Assessment Database located in Appendix A.

² Risk ID numbers 06, 07, 08, 12, 15, 19, 26, 27, & 28.

³ Risk ID numbers 22 & 23.

⁴ Including Cost, Start Date, Completion Date, Resources Required, Closure Criteria, & Fallback Strategy.

⁵ Ref. 2, §3.6.

Table 1. Risk Assessment Summary

Risk ID	Title	Technology	WBS Element	Subject Area / Functional Area	Risk Assessment	Handling Action	HA Effectiveness	HA Success Probability
01	Performance of R&D on Project Critical Path	Melt & Dilute	X.0	Manufacturing Facility / Project Management	High	Mitigate	Moderate	100%
02	SNF Characterization Required at Receiving	Melt & Dilute	X.2.2	Manufacturing Facility / Characterization	Low	Accept	Low	100%
03	SNF Characterization Required at Receiving	Direct Co-Disposal	X.2.2	Manufacturing Facility / Characterization	High	Mitigate	Low	85%
04	Accurate Reports of Material Received	Melt & Dilute	X.2.2	Manufacturing Facility / Characterization	Moderate	Mitigate	Low	100%
05	Accurate Reports of Material Received	Direct Co-Disposal	X.2.2	Manufacturing Facility / Characterization	Moderate	Mitigate	Low	100%
09	Quality of Final Product	Melt & Dilute	X.2.4	Manufacturing Facility / Packaging	Low	Accept	Low	100%
10	Quality of Final Product	Direct Co-Disposal	X.2.4	Manufacturing Facility / Packaging	Low	Accept	Low	100%
11	Non-Fuel Products Received in SNF	Melt & Dilute	X.2.4	Manufacturing Facility / Packaging	Low	Accept	Low	100%
13	Behavior of Fuels During Melt-Dilute	Melt & Dilute	X.2.12	Manufacturing Facility / Furnace Melt & Dilute	Moderate	Mitigate	Low	95%
14	Furnace Melt & Dilute System Performance	Melt & Dilute	X.2.12	Manufacturing Facility / Furnace Melt & Dilute	Low	Accept	Low	100%
16	Disposition of Off Gas System Waste	Melt & Dilute	X.2.13	Manufacturing Facility / Off Gas system	Low	Accept	Low	100%
17	Capture and Retention of HLW Materials	Melt & Dilute	X.2.13	Manufacturing Facility / Off Gas system	Low	Accept	Low	100%
18	Cleaning HLW Materials from Off Gas System	Melt & Dilute	X.2.13	Manufacturing Facility / Off Gas system	Low	Accept	Low	100%
20	Meeting k_{eff} Requirements	Melt & Dilute	Y.1.6	Disposal Form / Nuclear Criticality Safety	Moderate	Mitigate	Low	95%
21	Meeting k_{eff} Requirements	Direct Co-Disposal	Y.1.6	Disposal Form / Nuclear Criticality Safety	High	Mitigate	Moderate	100%

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Table 1. Risk Assessment Summary (Cont.)

Risk ID	Title	Technology	WBS Element	Subject Area / Functional Area	Risk Assessment	Handling Action	HA Effectiveness	HA Success Probability
22	Absence of Radioactive Release Requirements for Disposal Form in Disposal Zone	Melt & Dilute	Y.1.7	Disposal Form / Engineered Barriers	High	Transfer	N/A	N/A
23	Absence of Radioactive Release Requirements for Disposal Form in Disposal Zone	Direct Co-Disposal	Y.1.7	Disposal Form / Engineered Barriers	High	Transfer	N/A	N/A
24	Absence of Design Requirements for Disposal Form for 50+ Years Prior to Emplacement	Melt & Dilute	Y.1.7	Disposal Form / Engineered Barriers	Low	Accept	Low	100%
25	Absence of Design Requirements for Disposal Form for 50+ Years Prior to Emplacement	Direct Co-Disposal	Y.1.7	Disposal Form / Engineered Barriers	Low	Accept	Low	100%
29	Uncertainty in Waste Acceptance Criteria	Melt & Dilute	Y.1.11	Disposal Form / Certification per Disposal Criteria	Low	Accept	Low	100%
30	Uncertainty in Waste Acceptance Criteria	Direct Co-Disposal	Y.1.11	Disposal Form / Certification per Disposal Criteria	Low	Accept	Low	100%
31	Peak Clad Temperature Limitation Compliance	Direct Co-Disposal	Y.1.12	Disposal Form / Thermal Performance Considerations	High	Mitigate	Low	75%
32	Meeting Self Protection Requirements	Direct Co-Disposal	Y.1.8	Disposal Form / Radiation Shielding	Moderate	Mitigate	Low	100%
33	Performance of R&D on Project Critical Path	Direct Co-Disposal	X.0	Manufacturing Facility / Project Management	High	Mitigate	Moderate	100%

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CONCLUSIONS

The purpose of the SNF Alternative Technology Risk Assessment was to determine if either, or both, of the alternative technologies recommended by the RRTT posed significant risks that would make them unsuitable for further development. Based upon the results of this assessment, it is the conclusion of the risk assessment team that the Melt & Dilute and Direct Co-Disposal alternative technologies are both acceptable for further development provided mitigation strategies recommended by the team for *Moderate* and *High* risks are followed and tracked through completion by a project team. SFSD has committed to proceed with the risk management process throughout implementation of the Treatment and Storage Facility Project.

REFERENCES

1. Charles H. Kepner & Benjamin B. Tregoe. *The New Rational Manager*. McGraw-Hill, Princeton, NJ (1981).
2. John C. Devine, Jr., et. al. *Technical Strategy for the Treatment, Packaging, and Disposal of Aluminum-Based Spent Nuclear Fuel - A Report of the Research Reactor Spent Nuclear Fuel Task Team*. Prepared for the Department of Energy, Office of Spent Fuel Management (1996).
3. L. W. Patrick. *Risk Assessment Program Plan, Transfer and Storage Services for Aluminum-Based Spent Nuclear Fuel*. SRS Document G-ESR-G-00027, Rev. 0, Savannah River Site, Aiken, SC 29808 (1997).
4. Grant A. Cook, et. al. *Savannah River Site Spent Nuclear Fuel Transfer and Storage Services Pre-conceptual Design*. SRS Document G-CDP-G-00002, Rev. Draft B, Savannah River Site, Aiken, SC 29808 (1997).
5. *Conduct of Engineering and Technical Support, Technical Risk Analysis (Procedure 2.16, Rev. 0, 7/1/95)*. WSRC Manual E7, Savannah River Site, Aiken, SC 29808.
6. Andrew P. Sage. *Systems Engineering*. ISBN 0-471-53639-3, John Wiley & Sons, Inc., New York, NY (1992).
7. *Project Management and Control Methods, Project Risk Analysis (Guide 1.3, Rev. 0, 2/1/97)*. WSRC Manual WSRC-IM-95-00020, Savannah River Site, Aiken, SC 29808.
8. *Conduct of Project Management and Control, Project Risk Analysis (Procedure 2.62, Rev. 1, 2/1/97)*. WSRC Manual E11, Savannah River Site, Aiken, SC 29808.
9. Mark S. Abashian. *Mined Geologic Disposal System Waste Acceptance Criteria*. USDOE Report B00000000-01717-4600-00095, Rev. 00, TRW Environmental Safety Systems Inc., Las Vegas, NV 89134 (1997).
10. United States Code, Title 42, Chapter 108. *Nuclear Waste Policy*. (§10101. Definitions).
11. The Code of Federal Regulations, Title 10, Part 60. *Disposal of High-Level Radioactive Wastes in Geologic Repositories*.
12. *Quality Assurance Requirements and Description for the Civilian Radioactive Waste Management Program*. U.S. DOE Document DOE/RW-0333P
13. Joseph F. Krupa. *Savannah River Site Aluminum-Glad Spent Nuclear Fuel Alternative Cost Study Rev 1(U)*. USDOE Report WSRC-TR-97-299, Savannah River Site, Aiken, SC 29808 (1997).

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14. Robert L. Sindelar, et. al. *Alternative Aluminum Spent Nuclear Fuel Treatment Technology Development Status Report*. USDOE Report WSRC-TR-97-00345, Savannah River Site, Aiken, SC 29808 (1997).
15. The Code of Federal Regulations, Title 49, Part 173. *Shippers - General Requirements for Shipments and Packagings*.
16. ANSI N14.5-1997. *Radioactive Materials - Leakage Tests on Packages for Shipment*. American National Standards Institute, New York, NY 10036 (1997).
17. The Code of Federal Regulations, Title 10, Part 73. *Physical Protection of Plants and Materials*.
18. *Waste Acceptance System Requirements Document (WASRD)*. USDOE Document DOE/RW-0351P/E00000000-00811-1708-00001, Rev. 1, U.S. DOE Office of Civilian Radioactive Waste Management, Washington, DC 20585 (1994).

APPENDIXES

Appendix A: SNF Risk Assessment Database

Appendix A

SNF Risk Assessment Database

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Risk Assessment Database - General	A-2
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Risk Assessment Database - General

The risk assessment database that comprises this appendix is a collection of data on all the identified project risks and reflects the current status of each risk. A two-page database record exists for each of the identified risks and contains all of the pertinent information collected during the assessment process for that specific risk. The database was created in compliance with the requirements of Section 4 of the RAPP. Custody of the database will be transferred to SFSD Engineering following the issuance of this report.

Risk Assessment Database - Description

The following paragraphs identify the database field names and provide a brief description of the field contents in the context of the risk assessment process. The location of the field on each of the records (Page 1 and/or Page 2) is also identified.

RISK ID (Pages 1 & 2)

A unique serial number which is assigned to the record when each new risk is entered into the database. The new ID number is the last previous risk ID number incremented by 1.

ORIGIN DATE (Pages 1 & 2)

The calendar date for initial entry of risk information into the database.

REV NO (Pages 1 & 2)

The current revision number for the risk. Starts with 0 and increments by 1 each time the risk undergoes a change in nature or handling strategy.

STATUS DATE (Pages 1 & 2)

The calendar date of the last formal review of risk status. Also, the calendar date of the last updating of the risk record data.

STATUS (Pages 1 & 2)

Current status of record. Status will be either *Active*, *Closed*, or *Deleted*.

WBS ELEMENT (Pages 1 & 2)

The particular WBS element(s) which the risk will most likely impact (Ref. Figures 4 & 5 in the body of the report).

SUBJECT AREA (Pages 1 & 2)

The subject area under which the WBS element impacted by the risk may be found (Ref. Figures 4 & 5 in the body of the report).

FUNCTIONAL AREA (Pages 1 & 2)

The functional area description for the WBS element impacted by the risk (Ref. Figures 4 & 5 in the body of the report).

TECHNOLOGY (Pages 1 & 2)

The specific technology impacted by the risk. For this assessment, technology will be either *Direct Co-Disposal* or *Melt & Dilute*.

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TITLE (Pages 1 & 2)

A brief descriptive title for the risk.

RISK CATEGORY (Pages 1 & 2)

The technical risk category from Attachment 8.2 of WSRC Manual E7 Procedure 2.16. *T-1* indicates category 1 under *Technology*; *I-1* indicates category 1 under *Interfaces*; etc..

RISK FACET (Pages 1 & 2)

The risk type or facet. Facets may be *Technical Performance*, *Logistic Support*, *Disposition*, *Safety*, *Environmental*, *Programmatic*, *Cost*, or *Schedule*.

RISK ASSESSMENT (Pages 1 & 2)

The initial assessment results for risk grading, either *Low*, *Moderate*, or *High*.

RANK (Pages 1 & 2)

The current rank order number for the *Active* risks. The Risk Assessment Team determines this number. A rank of 1 indicates the most significant *Active* risk.

DESCRIPTION (Page 1)

A brief description of the risk and the basis for the risk. The basis includes a brief discussion of impacts if the risk were to occur, e.g., damaged SNF, unacceptable or rejected SNF disposal form, environmental releases, a contamination event, etc.

PROBABILITY OF RISK (Page 1)

Initial assessment of risk probability. The possible values of the field are *Very Unlikely*, *Unlikely*, and *Likely*.

RISK PROBABILITY SOURCE (Probability of Risk) (Page 1)

Indicates the source of the estimate. The possible values of the field are *Team Engineering Judgement* or *Technical Analysis*.

BASIS (Probability of Risk) (Page 1)

A brief statement that provides the basis for the assessed risk probability.

CONSEQUENCE OF RISK (Page 1)

Initial assessment of risk consequence(s). The possible values of the field are *Negligible*, *Marginal*, and *Critical*.

RISK CONSEQUENCE SOURCE (Consequence of Risk) (Page 1)

Indicates the source of the estimate. The possible values of the field are *Team Engineering Judgement* or *Technical Analysis*.

BASIS (Consequence of Risk) (Page 1)

A brief statement that provides the basis for the assessed risk consequence(s).

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HANDLING ACTION (Page 2)

Risk handling action recommended by Risk Team. The possible values of the field are *Mitigate, Avoid, Transfer, or Accept*.

BASIS (Handling Action) (Page 2)

A brief, high-level description of the risk handling action necessary to implement the strategy, with references to other documents for detail. Mitigation lists & summarizes recommended future development, study, modeling or other handling activities.

EFFECTIVENESS (Estimates for Handling Action) (Page 2)

The anticipated grade of the risk (*High, Moderate, or Low*) after a successful handling action is complete.

SUCCESS PROBABILITY (Estimates for Handling Action) (Page 2)

An estimate of the probability that handling action will be successful. Expressed in terms of percent.

COST (Estimates for Handling Action) (Page 2)

An estimate of the cost for performing the handling action.

START DATE (Estimates for Handling Action) (Page 2)

An estimate of the calendar date at which the handling action should begin

COMPLETION DATE (Estimates for Handling Action) (Page 2)

An estimate of the calendar date at which the handling action could be complete.

RESOURCE REQUIRED (Estimates for Handling Action) (Page 2)

A brief description of the people, tools, facilities and other resources needed to execute the handling action.

CLOSURE CRITERIA (Page 2)

The closure criteria that confirm a successful completion of handling action. Criteria must be met to initiate risk closure.

FALLBACK STRATEGY (Page 2)

A brief summary of an alternative handling action should the recommended handling action fail to manage the risk.

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Risk Assessment Database - Active Records

Risk ID	Title	Technology	WBS Element	Subject Area / Functional Area	Page
01	Performance of R&D on Project Critical Path	Melt & Dilute	X.0	Manufacturing Facility / Project Management	A-6 A-7
02	SNF Characterization Required at Receiving	Melt & Dilute	X.2.2	Manufacturing Facility / Characterization	A-8 A-9
03	SNF Characterization Required at Receiving	Direct Co-Disposal	X.2.2	Manufacturing Facility / Characterization	A-10 A-11
04	Accurate Reports of Material Received	Melt & Dilute	X.2.2	Manufacturing Facility / Characterization	A-12 A-13
05	Accurate Reports of Material Received	Direct Co-Disposal	X.2.2	Manufacturing Facility / Characterization	A-14 A-15
09	Quality of Final Product	Melt & Dilute	X.2.4	Manufacturing Facility / Packaging	A-16 A-17
10	Quality of Final Product	Direct Co-Disposal	X.2.4	Manufacturing Facility / Packaging	A-18 A-19
11	Non-Fuel Products Received in SNF	Melt & Dilute	X.2.4	Manufacturing Facility / Packaging	A-20 A-21
13	Behavior of Fuels During Melt-Dilute	Melt & Dilute	X.2.12	Manufacturing Facility / Furnace Melt & Dilute	A-22 A-23
14	Furnace Melt & Dilute System Performance	Melt & Dilute	X.2.12	Manufacturing Facility / Furnace Melt & Dilute	A-24 A-25
16	Disposition of Off Gas System Waste	Melt & Dilute	X.2.13	Manufacturing Facility / Off Gas system	A-26 A-27
17	Capture and Retention of HLW Materials	Melt & Dilute	X.2.13	Manufacturing Facility / Off Gas system	A-28 A-29
18	Cleaning HLW Materials from Off Gas System	Melt & Dilute	X.2.13	Manufacturing Facility / Off Gas system	A-30 A-31
20	Meeting k_{eff} Requirements	Melt & Dilute	Y.1.6	Disposal Form / Nuclear Criticality Safety	A-32 A-33
21	Meeting k_{eff} Requirements	Direct Co-Disposal	Y.1.6	Disposal Form / Nuclear Criticality Safety	A-34 A-35
22	Absence of Radioactive Release Requirements for Disposal Form in Disposal Zone	Melt & Dilute	Y.1.7	Disposal Form / Engineered Barriers	A-36 A-37
23	Absence of Radioactive Release Requirements for Disposal Form in Disposal Zone	Direct Co-Disposal	Y.1.7	Disposal Form / Engineered Barriers	A-38 A-39
24	Absence of Design Requirements for Disposal Form for 59+ Years Prior to Emplacement	Melt & Dilute	Y.1.7	Disposal Form / Engineered Barriers	A-40 A-41
25	Absence of Design Requirements for Disposal Form for 59+ Years Prior to Emplacement	Direct Co-Disposal	Y.1.7	Disposal Form / Engineered Barriers	A-42 A-43
29	Uncertainty in Waste Acceptance Criteria	Melt & Dilute	Y.1.11	Disposal Form / Certification per Disposal Criteria	A-44 A-45
30	Uncertainty in Waste Acceptance Criteria	Direct Co-Disposal	Y.1.11	Disposal Form / Certification per Disposal Criteria	A-46 A-47
31	Peak Clad Temperature Limitation Compliance	Direct Co-Disposal	Y.1.12	Disposal Form / Thermal Performance Considerations	A-48 A-49
32	Meeting Self Protection Requirements	Direct Co-Disposal	Y.1.8	Disposal Form / Radiation Shielding	A-50 A-51
33	Performance of R&D on Project Critical Path	Direct Co-Disposal	X.0	Manufacturing Facility / Project Management	A-52 A-53

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SNF Risk Assessment

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Risk ID 01	Origin Date 11/19/97	Rev No. 2	Status Date 07/13/98	Status Active	WBS Element X.0	Subject Area Manufacturing Facility	Functional Area Project Management	Technology Melt & Dilute
Title Performance of R&D on Project Critical Path							Risk Category D-5: Numerous or unclear assumptions or modification basis.	Risk Face Programmatic
Description R&D for the SNF disposal form and for the manufacturing facility are on or near the project's critical path. It is assumed that completion of R&D can occur within the normal project schedule. There is risk that normal R&D iterations can invalidate this assumption.							Probability of Risk Likely Basic Potential funding shortfalls could delay completion of R&D efforts.	Risk Assessment High
							Risk Consequence Source Team Engineering Judgement	
							Consequence of Risk Critical Basic Normal R&D iterations can have severe negative impacts on project cost and schedule.	

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SNF Risk Assessment

Risk ID 01	Origin Date 11/19/97	Rev No. 2	Status Date 07/13/98	Status Active	WBS Element X.0	Subject Area Manufacturing Facility	Functional Area Project Management	Technology Melt & Dilute										
Title Performance of R&D on Project Critical Path						Risk Category D-5: Numerous or unclear assumptions or modification basis.		Risk Facet Programmatic										
								Risk Assessment High										
Handling Action Mitigate Basis The project has been phased so that there is a design only project followed by a construction project. This will limit the financial liability that could be incurred if the R&D does not support the project assumptions. Additionally, the R&D efforts have been prioritized to focus early work on the most likely areas of concern.						Closure Criteria (TBD)												
Estimates for Handling Action <table border="1"> <tr> <td>Effectiveness</td> <td>Success Probability</td> <td>Cost</td> <td>Start Date</td> <td>Completion Date</td> </tr> <tr> <td>Moderate</td> <td>100%</td> <td>(TBD)</td> <td>(TBD)</td> <td>(TBD)</td> </tr> </table>						Effectiveness	Success Probability	Cost	Start Date	Completion Date	Moderate	100%	(TBD)	(TBD)	(TBD)	Fallback Strategy (TBD)		
Effectiveness	Success Probability	Cost	Start Date	Completion Date														
Moderate	100%	(TBD)	(TBD)	(TBD)														
Resources Required (TBD)																		

SNF Risk Assessment

Record Page 1 of 2

Risk ID 02	Origin Date 11/12/97	Rev No. 2	Status Date 07/13/98	Status Active	WBS Element X.2.2	Subject Area Manufacturing Facility	Functional Area Characterization	Technology Melt & Dilute
Title SNF Characterization Required at Receiving						Risk Category D-1: Undefined, incomplete or unclear functional requirements.		Risk Facet Technical Performance Risk Assessment Low Rank
Description SNF characterization is required upon receipt at SRS. It is assumed that only nominal characterization (visual, dimensional, serial number, etc.) is required at this time. This characterization will depend mostly on check offs, and will not require detailed characterization methods. Should additional requirements for characterization at receipt inspection be imposed the project would be required to do more to address the new requirements.						Probability of Risk Very Unlikely Risk Probability Source Team Engineering Judgement Basis The furnace Melt-Dilute process will provide the needed characterization data for the disposal form through sampling/analysis. Consequently, it is very unlikely that the characterization station will be required to provide anything more than simple check offs that confirm receipt of the correct material.		
						Consequence of Risk Negligible Risk Consequence Source Team Engineering Judgement Basis The only characterization that the furnace does not obviate is the ²³⁵ U content for nuclear criticality safety. In lag storage and the furnace itself, judicious design should make both of these processes criticality-safe for any maximum credible ²³⁵ U loading without any impact on project cost or schedule.		

SNF Alternative Technology Risk Assessment - Appendix A

SNF Risk Assessment

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Risk ID 02	Origin Date 11/12/97	Rev No. 2	Status Date 07/13/98	Status Active	WBS Element X.2.2	Subject Area Manufacturing Facility	Functional Area Characterization	Technology Melt & Dilute
Title SNF Characterization Required at Receiving					Risk Fact Technical Performance			
Risk Category D-1: Undefined, incomplete or unclear functional requirements.					Risk Assessment Low			
Handling Action Accept					Closure Criteria (N/A)			
Basis At the present time the project will accept Appendix A characterization data as written and will not perform special tests to gain more detailed characterization.								
Estimates for Handling Action					Fallback Strategy (N/A)			
Effectiveness Low	Success Probability 100%	Cost (N/A)	Start Date (N/A)	Completion Date (N/A)				
Resources Required (N/A)								

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SNF Risk Assessment

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Risk ID 03	Origin Date 11/13/97	Rev No. 2	Status Date 07/13/98	Status Active	WBS Element X.2.2	Subject Area Manufacturing Facility	Functional Area Characterization	Technology Direct Co-Disposal
Title SNF Characterization Required at Receiving					Risk Category D-1: Undefined, incomplete or unclear functional requirements.			
Description SNF characterization is required upon receipt at SRS. The MGDS WAC (Ref. 9) identifies various information regarding the SNF that must be provided by SRS, however it is not yet determined what form or accuracy is required for the data (i.e., is it necessary to identify isotopic quantities, pyrophoric or hazardous contents, etc., in the fuel, or is it acceptable to simply verify that fuel constituents are below given limits?). At the present time the project calls for assaying (sampling) SNF and assessing, through calculations, whether the remainder is within isotopic limits, and using historical data to evaluate hazardous, pyrophoric, etc. contents. The project has assumed that this is acceptable and is designing the facility accordingly, as this is consistent with the MGDS WAC. There is a risk that the final MGDS WAC will impose additional characterization information requirements for the SNF disposal form.					Probability of Risk Unlikely Risk Probability Source Team Engineering Judgement Basis The preliminary nature of the MGDS WAC makes minor changes likely in the future. The Direct Co-Disposal form design already addresses the major characterization issues, making it unlikely that major changes to the facility will be necessary to accommodate these WAC changes.			
					Consequence of Risk Critical Basis Should additional requirements for characterization at receipt inspection be imposed, the project would be required to do more to address the new requirements. Depending upon the required information, additional characterization of the SNF may be needed and data may need to be measured instead of calculated. This change could result in a need for additional equipment and a minor redesign, or it may result in a somewhat slower process. In either case, impact may exceed 10% of project schedule and/or life cycle cost of facility.			

SNF Risk Assessment

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Risk ID 03	Origin Date 11/13/97	Rev No. 2	Status Date 07/13/98	Status Active	WRS Element X.2.2	Subject Area Manufacturing Facility	Functional Area Characterization	Technology Direct Co-Disposal
Title SNF Characterization Required at Receiving					Risk Category D-1: Undefined, incomplete or unclear functional requirements.			
Handling Action Mitigate					Risk Facet Technical Performance High			
<p>Decis</p> <p>The design calls for assaying SNF and assessing through calculations, whether it is within isotopic limits and using historical data to evaluate hazardous, pyrophoric, etc. contents. The design needs to be flexible (provide space, infrastructure, etc.) to accommodate additional characterization should it be required. A contingency should also be added to operating costs for the additional characterization.</p>					<p>Closure Criteria (TBD)</p>			
<p>Estimates for Handling Action</p> <p>Effectiveness Low</p> <p>Success Probability 85%</p> <p>Cost (TBD)</p> <p>Start Date (TBD)</p> <p>Completion Date (TBD)</p> <p>Resources Required (TBD)</p>					<p>Fallback Strategy (TBD)</p>			

Record Page 1 of 2

Risk ID 04	Origin Date 11/12/97	Rev No. 2	Status Date 07/13/98	Status Active	WBS Element X.2.2	Subject Area Manufacturing Facility	Functional Area Characterization	Technology Melt & Dilute		
Title Accurate Reports of Material Received							Risk Category I-1: Multiple system interfaces.	Risk Facet Disposition		
								Risk Assessment Moderate	Rank	
Description SRS will be processing SNF generated by other organizations, under control systems which differ from SRS's current programs. It is assumed that SRS will receive sufficiently accurate records of the legacy materials being received such that the material can be processed within the system as designed. There is a risk that material will be received that is not reflected in the records, and that it cannot be processed by SRS.							Probability of Risk Likely			Risk Probability Source Team Engineering Judgement
							Basis Based upon experience to date, some records will not fully reflect materials received for processing.			
							Consequence of Risk Negligible			Risk Consequence Source Team Engineering Judgement
							Basis Inaccurate records could result in the receipt of materials which SRS is not prepared to handle. If all received material is fuel related, then bounding analyses will allow the system to accommodate and process the material. If material is not fuel related, a new strategy would be required, but this is not expected to impact this project's cost or schedule.			

SNF Risk Assessment

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Risk ID 04	Origin Date 11/12/97	Rev No. 2	Status Date 07/13/98	Status Active	WBS Element X.2.2	Subject Area Manufacturing Facility	Functional Area Characterization	Technology Melt & Dilute
Title Accurate Reports of Material Received					Risk Category I-1: Multiple system interfaces.		Risk Facet Disposition Moderate	
<p>Handling Action Mitigate</p> <p>Issue</p> <p>The project needs to:</p> <ol style="list-style-type: none"> 1) Develop a position on handling material received which is outside the limits of the records received; 2) Develop administrative controls to process materials in an alternate manner; <p>or,</p> <ol style="list-style-type: none"> 3) Modify the facility to accept certain variant materials. <p>The material may simply require more characterization to make it acceptable.</p>					<p>Closure Criteria (TBD)</p>			
<p>Estimates for Handling Action</p> <p>Effectiveness Low</p> <p>Success Probability 100%</p> <p>Cost (TBD)</p> <p>Start Date (TBD)</p> <p>Completion Date (TBD)</p> <p>Resources Required (TBD)</p>					<p>Fallback Strategy (TBD)</p>			

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SNF Risk Assessment

Risk ID 05	Origin Date 11/12/97	Rev No. 2	Status Date 07/13/98	Status Active	WBS Element X.2.2	Subject Area Manufacturing Facility	Functional Area Characterization	Technology Direct Co-Disposal
Title Accurate Reports of Material Received						Risk Category I-1: Multiple system interfaces.		Risk Facet Disposition Risk Assessment Moderate Rank
Description SRS will be processing SNF generated by other organizations, under control systems which differ from SRS's current programs. It is assumed that SRS will receive sufficiently accurate records of the legacy materials being received such that the material can be processed within the system as designed. There is a risk that material will be received that is not reflected in the records, and that it cannot be processed by SRS.						Probability of Risk Likely Risk Probability Source Team Engineering Judgement		
						Basis Based upon experience to date, some records will not fully reflect materials received for processing.		
						Consequence of Risk Negligible Risk Consequence Source Team Engineering Judgement		
						Basis Inaccurate records could result in the receipt of materials which SRS is not prepared to handle. If all received material is fuel related, then bounding analyses will allow the system to accommodate and process the material. If material is not fuel related, a new strategy would be required, but this is not expected to impact this project's cost or schedule.		

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Record Page 2 of 2

SNF Risk Assessment

Risk ID 05	Origin Date 11/12/87	Rev No. 2	Status Date 07/13/98	Status Active	WBS Element X.2.2	Subject Area Manufacturing Facility	Functional Area Characterization	Technology Direct Co-Disposal										
Title Accurate Reports of Material Received						Risk Category I-1: Multiple system interfaces.		Risk Facet Disposition Risk Assessment Moderate Rank										
Handling Action Mitigate Basis The project needs to: 1). Develop a position on handling material received which is outside the limits of the records received; 2). Develop administrative controls to process materials in an alternate manner; or, 3). Modify the facility to accept certain variant materials. The material may simply require more characterization to make it acceptable.						Closure Criteria (TBD)												
Estimates for Handling Action <table border="1"> <tr> <td>Effectiveness</td> <td>Success Probability</td> <td>Cost</td> <td>Start Date</td> <td>Completion Date</td> </tr> <tr> <td>Low</td> <td>100%</td> <td>(TBD)</td> <td>(TBD)</td> <td>(TBD)</td> </tr> </table>						Effectiveness	Success Probability	Cost	Start Date	Completion Date	Low	100%	(TBD)	(TBD)	(TBD)	Feedback Strategy (TBD)		
Effectiveness	Success Probability	Cost	Start Date	Completion Date														
Low	100%	(TBD)	(TBD)	(TBD)														
Resources Required (TBD)																		

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SNF Risk Assessment

Risk ID 09	Origin Date 11/12/97	Rev No. 2	Status Date 07/13/98	Status Active	WBS Element X.2.4	Subject Area Manufacturing Facility	Functional Area Packaging	Technology Melt & Dilute
Title Quality of Final Product						Risk Category D-1: Undefined, incomplete or unclear functional requirements.		Risk Facet Technical Performance Risk Assessment Low
Description The MGDS WAC requires processed SNF to be packaged such that materials are not combustible, pyrophoric, organic or chemically reactive over a temperature range of 25 to 400°C and a pressure range of 1 to 5 atmospheres. The packaging limits have not yet been defined in the MGDS WAC which will ensure acceptance at the repository. Additionally, canister internal pressure cannot exceed 150 kPa over the entire range of all projected canister temperatures. The project assumes that a disposal form will be generated which will comply with the limits when they are established. There is a risk that packaging limits will be so stringent that the project will have difficulty meeting them.						Probability of Risk Very Unlikely Risk Probability Source Team Engineering Judgement Basis The proposed waste form is expected to be inherently stable under the normal storage condition. Non of the materials packaged in the waste form are expected to contain combustible, pyrophoric, organic or chemically reactive constituents. Consequently, it is very unlikely that the disposal form will have difficulty meeting the packaging limits. Likewise, all free fission gases and high vapor pressure elements will be released during the Melt-Dilute process, making it very unlikely that significant out gassing will occur from the disposal form and over pressurize the canister. However, research into this issue should continue to confirm these expectations.		
						Consequence of Risk Negligible Risk Consequence Source Team Engineering Judgement Basis Should the packaging limits for combustibles, etc., be very stringent, rework of the disposal form will be necessary. The life cycle cost and schedule impacts of this rework should not exceed 5% provided DOE-RW establishes these limits in 1998 as currently scheduled.		

SNF Risk Assessment

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Risk ID 09	Origin Date 11/12/97	Rev No. 2	Status Date 07/13/98	Status Active	WSS Element X.2.4	Subject Area Manufacturing Facility	Functional Area Packaging	Technology Melt & Dilute
Title Quality of Final Product					Risk Category D-1: Undefined, incomplete or unclear functional requirements.			
Handling Action Accept					Risk Fact Technical Performance			
Basic At the present time the project will accept this risk.					Risk Assessment LOW			
Failure Criteria (N/A)					Failure Strategy (N/A)			
Estimates for Handling Action					Completion Date (N/A)			
Effectiveness LOW	Success Probability 100%	Cost (N/A)	Start Date (N/A)					
Resources Required (N/A)								

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SNF Risk Assessment

Risk ID 10	Origin Date 11/12/97	Rev No. 2	Status Date 07/13/98	Status Active	WBS Element X.2.4	Subject Area Manufacturing Facility	Functional Area Packaging	Technology Direct Co-Disposal
Title Quality of Final Product						Risk Category D-1: Undefined, incomplete or unclear functional requirements.		Risk Facet Technical Performance
								Risk Assessment Low
Description The MGDS WAC requires processed SNF to be packaged such that materials are not combustible, pyrophoric, organic or chemically reactive over a temperature range of 25 to 400°C and a pressure range of 1 to 5 atmospheres. The packaging limits have not yet been defined in the MGDS WAC which will ensure acceptance at the repository. Additionally, canister internal pressure cannot exceed 150 kPa over the entire range of all projected canister temperatures. The project assumes that a disposal form will be generated which will comply with the limits when they are established. There is a risk that packaging limits will be so stringent that the project will have difficulty meeting them.						Probability of Risk Very Unlikely		
						Risk Probability Source Team Engineering Judgement		
						Basis The SNF form is inherently stable under the normal storage conditions. The use of a vacuum dryer will reduce the amount of free water in the sealed canister to reduce the radiolytic generation of hydrogen gas. The relatively low temperature of the repository disposal environment makes it very unlikely that intact SNF assemblies will out gas significantly to over pressurize the canister. Even though SNF is not expected to contain combustible, pyrophoric, organic or chemically reactive constituents, it is also very unlikely that the characterization station, as currently conceptualized, will fail to detect these constituents so that compliance with the packaging limits are assured. However, research into this issue should continue to confirm these expectations.		
						Consequence of Risk Negligible		
						Risk Consequence Source Team Engineering Judgement		
						Basis Should the packaging limits for combustibles, etc., be very stringent, rework of the disposal form will be necessary. The life cycle cost and schedule impacts of this rework should not exceed 5% provided DOE-RW establishes these limits in 1998 as currently scheduled.		

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Risk ID 10	Origin Date 11/12/97	Rev No. 2	Status Date 07/13/98	Status Active	WSS Element X.2.4	Subject Area Manufacturing Facility	Functional Area Packaging	Technology Direct Co-Disposal
Title Quality of Final Product				Risk Category D-1: Undefined, incomplete or unclear functional requirements.				
Handling Action Accept				Risk Facet Technical Performance				
Goals At the present time the project will accept this risk.				Risk Assessment LOW				
Estimates for Handling Action Effectiveness Low				Failure Strategy (N/A)				
Success Probability 100%				Completion Date (N/A)				
Resources Required (N/A)				Start Date (N/A)				
				Cost (N/A)				

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Risk ID 11	Origin Date 11/12/97	Rev No. 1	Status Date 07/13/98	Status Active	WBS Element X.2.4	Subject Area Manufacturing Facility	Functional Area Packaging	Technology Melt & Dilute
Title Non-Fuel Products Received in SNF						Risk Category T-3: New application of existing technology.		Risk Facet Technical Performance Risk Assessment Low Rank
Description There may be some unknown non-fuel related materials received in the SNF or some process upsets (e.g. - foaming or slag productions) which could result in a U-Al ingot which is unacceptable to the repository. The current TSS design will detect a range of anticipated non-fuel materials and process upsets and disposition these unacceptable U-Al ingots. Because this design has some first-of-a-kind features, there is a risk that the current design cannot detect a flawed U-Al ingot, and consequently, the process would not be pre-certified by DOE-RW. There is an additional risk that even if the design can detect the flaw, the current process cannot recycle the unacceptable ingot.						Probability of Risk Unlikely Risk Probability Source Team Engineering Judgement Basis The characterization station for the Melt-Dilute option is a simple check off without extensive examination of SNF. Data coming from the furnace melt provides the needed characterization of the disposal form. Without an extensive examination of SNF, non-fuel materials could escape detection and enter the furnace process at least once during the facility lifetime. Likewise, it is equally probable that these materials can cause furnace process upsets. However, because of the characterization sampling to be employed with Melt & Dilute, it is unlikely that any disposal forms will be created that are unacceptable to the repository.		
						Consequence of Risk Negligible Risk Consequence Source Team Engineering Judgement Basis The facility may produce one or two unacceptable U-Al ingot during the operating lifetime. These ingots would be handled and dispositioned on an ad hoc basis with minimal impact on the facility life cycle cost and schedule.		

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Risk ID 11	Origin Date 11/12/97	Rev No. 1	Status Date 07/13/98	Status Active	WBS Element X.2.4	Subject Area Manufacturing Facility	Functional Area Packaging	Technology Melt & Dilute
<div style="display: flex; justify-content: space-between;"> <div> <p>Title</p> <p>Non-Fuel Products Received in SNF</p> </div> <div> <p>Risk Category</p> <p>T-3: New application of existing technology.</p> </div> <div> <p>Risk Face</p> <p>Technical Performance</p> </div> </div>								
<div style="display: flex; justify-content: space-between;"> <div> <p>Handling Action</p> <p>Accept</p> </div> <div> <p>Basic</p> <p>At the present time the project will accept this risk.</p> </div> <div> <p>Risk Assessment</p> <p>LOW</p> </div> <div> <p>Rank</p> </div> </div>								
<div style="display: flex; justify-content: space-between;"> <div> <p>Estimates for Handling Action</p> <p>Effectiveness LOW</p> </div> <div> <p>Success Probability 100%</p> </div> <div> <p>Cost (N/A)</p> </div> <div> <p>Start Date (N/A)</p> </div> <div> <p>Completion Date (N/A)</p> </div> </div>								
<div style="display: flex; justify-content: space-between;"> <div> <p>Resources Required</p> <p>(N/A)</p> </div> <div> <p>Fallback Strategy</p> <p>(N/A)</p> </div> </div>								

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Risk ID 13	Origin Date 11/12/97	Rev No. 2	Status Date 07/13/98	Status Active	WRS Element X.2.12	Subject Area Manufacturing Facility	Functional Area Furnace Melt and Dilute	Technology Melt & Dilute	
<p>Title Behavior of Fuels During Melt-Dilute</p>					<p>Risk Category T-2: Unknown or unclear technology.</p>				<p>Risk Fact Technical Performance</p>
<p>Description Spent nuclear fuels will change state during processing. It is uncertain how the spent fuels will behave metallurgically since a large scale integrated Melt-Dilute process has not been demonstrated. The project design assumes that unirradiated U-Al metallurgy adequately reflects the metallurgy of SNF. There is a risk that SNF metallurgy could invalidate that assumption.</p>					<p>Probability of Risk Unlikely <small>Basis</small> ANL -West is now melting EBR fuels with no reported problems of low melting eutectics from fission products. Tests at SRS and other laboratories for reactor safety studies have been completed using irradiated U-Al alloy and oxide fuels. In addition, the project plans to melt irradiated fuel to demonstrate the concept. Calculations have been completed for the expected fission products in highly irradiated MTR fuels; results show only trace amounts of these elements. Consequently, it is unlikely that SNF metallurgy will present significant problems during the Melt-Dilute process.</p>				<p>Risk Assessment Moderate</p>
					<p>Consequence of Risk Marginal <small>Basis</small> If the SNF metallurgy differs from the design basis metallurgy, a minor redesign of the furnace process may be necessary to deal with the fission and activation products.</p>				
					<p>Risk Consequence Source Team Engineering Judgement</p>				

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Risk ID	Origin Date	Rev No.	Status Date	Status	WBS Element	Subject Area	Functional Area	Technology
13	11/12/97	2	07/13/98	Active	X.2.12	Manufacturing Facility	Furnace Melt and Dilute	Melt & Dilute
Title Behavior of Fuels During Melt-Dilute						Risk Category T-2: Unknown or unclear technology.		Risk Facet Technical Performance
								Risk Assessment Moderate
Handling Action Mitigate Basis Use data from existing processes to predict outputs. Demonstrate the system prior to final design. Retrieve data from Argonne-West for actual melt-dilute of spent fuels.						Closure Criteria (TBD)		
Estimates for Handling Action						Fallback Strategy (TBD)		
Effectiveness	Success Probability	Cost	Start Date	Completion Date				
Low	95%	(TBD)	(TBD)	(TBD)				
Resources Required (TBD)								

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Risk ID 14	Origin Date 11/12/97	Rev No. 2	Status Date 07/13/98	Status Active	WBS Element X.2.12	Subject Area Manufacturing Facility	Functional Area Furnace Melt and Dilute	Technology Melt & Dilute
Title Furnace Melt and Dilute System Performance						Risk Category I-1: Multiple system interfaces.		Risk Facet Technical Performance
						Risk Assessment Low		Rank
Description The integrated system planned for the furnace Melt-Dilute system is a first-of-a-kind, although the individual subsystems and components are not. Based on the technology available, site personnel are assuming that system operation can be predicted. There is a risk that the integrated system will encounter interface or other first-of-a-kind problems which will prevent it from performing as predicted.						Probability of Risk Unlikely Risk Probability Source Team Engineering Judgement Basis Although the application is first-of-a-kind, the concept is not new and the design complexity is not high. Part of the ANL-West electrometallurgical process utilizes similar process steps. Based upon their experience, it is unlikely that the system will encounter any major integration problems.		
						Consequence of Risk Negligible Risk Consequence Source Team Engineering Judgement Basis Should system integration problems occur, minor redesign will be necessary to insure correct interfaces. Costs of redesign necessary to resolve any interface problems are expected to be below 5% of the life cycle cost and schedule.		

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SNF Risk Assessment

Risk ID 14	Origin Date 11/12/97	Rev No. 2	Status Date 07/13/98	Status Active	WBS Element X.2.12	Subject Area Manufacturing Facility	Functional Area Furnace Melt and Dilute	Technology Melt & Dilute
Title Furnace Melt and Dilute System Performance						Risk Category I-1: Multiple system interfaces.		Risk Facet Technical Performance Risk Assessment Low
Handling Action Accept Basis At the present time the project will accept this risk.						Closure Criteria (N/A)		
Estimates for Handling Action Effectiveness Low Success Probability 100% Cost (N/A) Start Date (N/A) Completion Date (N/A)						Fallback Strategy (N/A)		
Resources Required (N/A)								

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Risk ID 16	Origin Date 11/12/97	Rev No. 2	Status Date 07/13/98	Status Active	WBS Element X.2.13	Subject Area Manufacturing Facility	Functional Area Off Gas System	Technology Melt & Dilute
Title Disposition of Off Gas System Waste					Risk Category R/E-3: Undefined disposal methods.			
Description The process to clean the off gas system and the process to treat the removed fission and activation products will generate contaminated liquid and solid waste. These wastes could very well be classified as HLW. The project assumes that the wastes resulting from the cleaning and treatment systems can be handled by existing SRS processes. There is a risk that the HLW stream will require additional processing before ultimate disposal.					Risk Fact Disposition Risk Assessment LOW Rank			
Probability of Risk Very Unlikely Basis Existing SRS processes have been designed to handle waste streams from U-Al spent fuel. It is very unlikely that the Melt-Dilute process will generate any waste streams that will challenge existing SRS processes.					Risk Probability Source Team Engineering Judgement			
Consequence of Risk Negligible Basis The existing SRS processes have a proven record for handling a wide array of waste streams. Any required redesign to accommodate furnace off gas waste streams would be minor.					Risk Consequence Source Team Engineering Judgement			

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Risk ID 16	Origin Date 11/12/97	Rev No. 2	Status Date 07/13/98	Status Active	WBS Element X.2.13	Subject Area Manufacturing Facility	Functional Area Off Gas System	Technology Melt & Dilute
Title Disposition of Off Gas System Waste				Risk Category R/E-3: Undefined disposal methods.				
Handling Action Accept				Risk Facet Disposition				
Basis At the present time the project will accept this risk.				Risk Assessment LOW				
Estimates for Handling Action				Feedback Strategy				
Effectiveness LOW	Success Probability 100%	Cost (N/A)	Start Date (N/A)	Completion Date (N/A)	(N/A)			
Resources Required (N/A)								

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Risk ID 17	Origin Date 11/12/97	Rev No. 2	Status Date 07/13/98	Status Active	WBS Element X.2.13	Subject Area Manufacturing Facility	Functional Area Off Gas System	Technology Melt & Dilute	
Title Capture and Retention of HLW Materials						Risk Category T-3: New application of existing technology.		Risk Facet Technical Performance	
								Risk Assessment Low	
								Rank	
Description The relatively high temperatures of the melt-dilute furnace will release significant fractions of cesium, strontium, technetium and other volatile fission products from molten U-Al spent fuel. Activation products will also volatilize and escape the molten alloy. The furnace off gas system must capture and retain the fission products and activation products for what could be considerable time periods before eventual disposal as high level waste. During the entire time period, radioactive releases from the off gas system to the environment must be within regulatory limits. Risks are likely to come from the elemental form and relatively high temperatures of the solid, gaseous and liquid forms of the various fission and activation products. Special tests will likely be necessary to identify the risks and develop ways to handle them.						Probability of Risk Very Unlikely			Risk Probability Source Team Engineering Judgement
						Basis SRS and the industry have considerable experience in designing and operating off gas systems successfully. Based upon the performance of the off gas system in the EBR fuel melt experience of ANL-West, the probability is very unlikely that off gas requirements for the Melt-Dilute furnace will present problems that cannot be resolved using existing industrial off gas system technology.			
						Consequence of Risk Negligible			
						Risk Consequence Source Team Engineering Judgement			
						Basis The impacts of any modifications to the off gas system which may be necessary to meet performance requirements are expected to be no greater than 5% of project schedule and/or life cycle cost.			

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Risk ID 17	Origin Date 11/12/97	Rev No. 2	Status Date 07/13/98	Status Active	WBS Element X.2.13	Subject Area Manufacturing Facility	Functional Area Off Gas System	Technology Melt & Dilute	
<div style="display: flex; justify-content: space-between;"> <div> <p>Title</p> <p>Capture and Retention of HLW Materials</p> </div> <div> <p>Risk Category</p> <p>T-3: New application of existing technology.</p> </div> <div> <p>Risk Facet</p> <p>Technical Performance</p> </div> </div>									
<p>Handling Action</p> <p>Accept</p> <p>Status</p> <p>At the present time the project will accept this risk.</p>					<p>Closure Criteria</p> <p>(N/A)</p>				<p>Risk Assessment</p> <p>Low</p>
<p>Estimates for Handling Action</p> <p>Effectiveness</p> <p>LOW</p> <p>Success Probability</p> <p>100%</p> <p>Cost</p> <p>(N/A)</p> <p>Start Date</p> <p>(N/A)</p> <p>Completion Date</p> <p>(N/A)</p> <p>Resources Required</p> <p>(N/A)</p>					<p>Feedback Strategy</p> <p>(N/A)</p>				

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SNF Risk Assessment

Risk ID 18	Origin Date 11/12/97	Rev No. 2	Status Date 07/13/98	Status Active	WBS Element X.2.13	Subject Area Manufacturing Facility	Functional Area Off Gas System	Technology Melt & Dilute
Title Cleaning HLW Materials from Off Gas System						Risk Category T-3: New application of existing technology.		Risk Facet Technical Performance
Description <p>The relatively large temperature profiles of the melt-dilute furnace off gas system will cause some volatile HLW materials to condense and plate on the walls of the system. Other HLW materials will flow to filters and traps where they are captured. Thus a distribution of radioactivity within the off gas system will grow with time and eventually require retrieval. The intense radiation levels will require remote handling during the retrieval effort.</p> <p>The cleaning process steps are undefined at this time, and will depend on the concentration and physical form of radionuclides that have plated out. Interactions between the nuclides and the wall materials could also have an effect on the process steps. There is a risk that a first-attempt process and design for a cleaning system will be inadequate.</p>						Risk Assessment LOW		Rank
						Probability of Risk Unlikely		Risk Probability Source Team Engineering Judgement
						Consequence of Risk Negligible		Risk Consequence Source Team Engineering Judgement
						Basis <p>The impacts of any modifications to the off gas cleaning system which may be necessary to meet performance requirements are expected to be no greater than 5% of project schedule and/or life cycle cost.</p>		

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Risk ID 18	Origin Date 11/12/97	Rev No. 2	Status Date 07/13/98	Status Active	WBS Element X.2.13	Subject Area Manufacturing Facility	Functional Area Off Gas System	Technology Melt & Dilute
Title Cleaning HLW Materials from Off Gas System					Risk Category T-3: New application of existing technology.			
Handling Action Accept					Risk Facet Technical Performance			
Basic At the present time the project will accept this risk.					Risk Assessment LOW			
Chorus Criteria (N/A)								
Estimates for Handling Action					Failure Strategy (N/A)			
Effectiveness LOW	Success Probability 100%	Cost (N/A)	Start Date (N/A)	Completion Date (N/A)				
Resources Required (N/A)								

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SNF Risk Assessment

Risk ID	Origin Date	Rev No.	Status Date	Status	WBS Element	Subject Area	Functional Area	Technology						
20	11/10/97	2	07/13/98	Active	Y.1.6	Disposal Form	Nuclear Criticality Safety	Melt & Dilute						
Title Meeting k_{eff} Requirements							Risk Category S-1: Criticality potential.		Risk Facet Technical Performance					
							Risk Assessment Moderate		Rank					
Description <p>k_{eff} must be maintained ≤ 0.95 and meet the double contingency principle. After some period of time, the waste disposal form will lose configuration control. The disposal form must be designed to meet the k_{eff} requirement for the worst case configuration. This design, however, has not had the benefit of a detailed nuclear criticality analysis. When these detailed analyses are completed, a redesign of the disposal form could be required to meet the k_{eff} requirement.</p> <p>The design team assumes that an adjustment of fuel and non-fuel material balance can be made to ensure the disposal form meets the k_{eff} requirements at the expense of an increase in the number of canisters to be produced and disposed. Without detailing the balances needed, the change in the number of disposal forms cannot be quantified at this time. There is a risk that the facility may need additional storage space to accommodate the greater number of disposal forms.</p>							Probability of Risk Unlikely				Risk Probability Source Team Engineering Judgement			
							Basis If k_{eff} requirement changes for the repository, then the Melt-Dilute disposal form can be further diluted using designed equipment, and no further facility development will be required. Current plans are evaluating the possibility of isotopic dilution to 2%. Since the volume change in the Melt-Dilute disposal form is driven mainly by the aluminum, it is unlikely that a significant increase in storage space at the TSS will be required.							
							Consequence of Risk Marginal				Risk Consequence Source Team Engineering Judgement			
							Basis Impacts of any redesign of the disposal form and/or the facility required to meet k_{eff} requirements at the repository are expected to be less than 10% of the project schedule and/or life cycle cost.							

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Risk ID 20	Origin Date 11/10/97	Rev No. 2	Status Date 07/13/98	Status Active	WBS Element Y.1.6	Subject Area Disposal Form	Functional Area Nuclear Criticality Safety	Technology Melt & Dilute
Title Meeting k _a Requirements							Risk Category S-1: Criticality potential.	Risk Facet Technical Performance
Handling Action Mitigate							Risk Assessment Moderate	Rank
Needs Perform criticality analysis to establish required dilution of Melt-Dilute disposal form.							Closure Criteria (TBD)	
Estimates for Handling Action Effectiveness Low							Start Date (TBD) Cost (TBD) Success Probability 95% Completion Date (TBD)	
Resources Required (TBD)								
Feedback Strategy (TBD)								

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SNF Risk Assessment

Risk ID 21	Origin Date 11/10/97	Rev No. 2	Status Date 07/13/98	Status Active	WBS Element Y.1.6	Subject Area Disposal Form	Functional Area Nuclear Criticality Safety	Technology Direct Co-Disposal
Title Meeting k_{eff} Requirements						Risk Category S-1: Criticality potential.		Risk Facet Technical Performance
								Risk Assessment High
Description <p>k_{eff} must be maintained ≤ 0.95 and meet the double contingency principle. After some period of time, the waste disposal form will lose configuration control. The disposal form must be designed to meet the k_{eff} requirement for the worst case configuration. This design, however, has not had the benefit of a detailed nuclear criticality analysis. When these detailed analyses are completed, a redesign of the disposal form could be required to meet the k_{eff} requirement.</p> <p>The design team assumes that an adjustment of fuel and non-fuel material balance can be made to ensure the disposal form meets the k_{eff} requirements at the expense of an increase in the number of canisters to be produced and disposed. Without detailing the balances needed, the change in the number of disposal forms cannot be quantified at this time. There is a risk that the facility may need additional storage space to accommodate the greater number of disposal forms.</p>						Probability of Risk Likely		Risk Probability Source Team Engineering Judgement
								Basis Since the worst case configuration has not yet been systematically determined and the current design is based upon an assumed configuration, the probability is likely that nuclear criticality analyses will dictate changes in the disposal form.
						Consequence of Risk Critical		Risk Consequence Source Team Engineering Judgement
								Basis Exceeding k_{eff} requirements will result in rejection of the disposal form by the repository. Redesign of the disposal form and/or the facility are expected to have significant impact on the life cycle cost and schedule of > 10%.

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Risk ID 21	Origin Date 11/10/97	Rev No. 2	Start Date 07/13/98	Status Active	WBS Element Y.1.6	Subject Area Disposal Form	Functional Area Nuclear Criticality Safety	Technology Direct Co-Disposal
Title Meeting k _{eff} Requirements				Risk Category S-1: Criticality potential.		Risk Facet Technical Performance		Rank High
Handling Action Mitigate				Closure Criteria (TBD)				
Block Perform criticality analysis to establish configuration requirements for the Direct Co-Disposal form.								
Estimates for Handling Action				Fallback Strategy (TBD)				
Effectiveness Moderate	Success Probability 100%	Cost (TBD)	Start Date (TBD)	Completion Date (TBD)				
Resources Required (TBD)								

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Risk ID 22	Origin Date 11/10/97	Rev No. 2	Status Date 07/13/98	Status Active	WBS Element Y.1.7	Subject Area Disposal Form	Functional Area Engineered Barriers	Technology Melt & Dilute
Title Absence of Radioactive Release Requirements for Disposal Form in Disposal Zone						Risk Category D-1: Undefined, incomplete or unclear functional requirements		Risk Facet Technical Performance
								Risk Assessment High
Description DOE-RW has not specified requirements pertaining to radioactive release from the Melt-Dilute disposal form after emplacement in the disposal zone.						Risk Probability Source Team Engineering Judgement		
<p>• For the first 1000 years, there is no need for a requirement. DOE-RW requires the disposal package to "substantially" contain all radioactivity. The project interprets this to mean no radioactivity will escape the disposal package for 1000 years. Because DOE-RW will design the outermost container to meet the "substantial" containment requirement, there is no requirement or impact on the Melt-Dilute disposal form.</p> <p>• Between 1000 and 10,000 years, there may be a need for a requirement pertaining to radioactive release rate from the disposal form. For this time period, 10CFR60 gives requirements for radionuclides escaping the repository engineered barrier. Per §60.113(a)(1)(ii)(B), the release rate of any radionuclide "...shall not exceed one part in 100,000 per year of the inventory of that radionuclide calculated to be present at 1,000 years following permanent closure,..." but not exceeding 10CFR20 limits.</p> <p>DOE-RW has not allocated the repository in toto requirements to the various types of DOE SNF disposal forms. The absence of a firm requirement means that design of the Melt-Dilute disposal form proceeds at risk.</p> <p>The Melt-Dilute disposal form development program will measure radioactive release rates for various disposal environments. A repository performance assessment will use the measured rates to determine if the repository meets the in toto release requirements of 10CFR60 with Melt-Dilute disposal forms emplaced.</p> <p>If the repository cannot meet the in toto requirement for radioactive release, a redesign of the Melt-Dilute disposal form will be necessary to achieve lower release rates.</p>						<p>Probability of Risk Very Unlikely</p> <p>Basis The SNF risk assessment team judges the probability of redesign to be very unlikely based on results of preliminary repository performance assessments to date. The preliminary assessments have indicated that the fission products inventory in the Melt-Dilute form is so low that an immediate release of 100% of inventory would not exceed dose limits for the general public.</p> <p>An in-depth assessment by subject matter experts will be necessary later to confirm acceptability of the Melt-Dilute disposal form design. This assessment must demonstrate that the repository, with Melt-Dilute disposal forms emplaced, meets <u>all</u> regulatory requirements.</p>		
						Risk Consequence Source Team Engineering Judgement		
						<p>Consequence of Risk Critical</p> <p>Basis The project assumes that redesign of the Melt-Dilute disposal form will not be necessary to meet a release rate limit. Instead, three other actions are possible, and any one of them will likely cause overruns exceeding 10%. The three actions are:</p> <ul style="list-style-type: none"> • DOE-RW will redesign its waste overpack to be more robust, with ≥ 10,000 year life before breach. Cost burdens will pass to the Melt-Dilute option. • DOE-RW will redesign the repository to achieve compliance with the release limit. This could include reducing the number of Melt-Dilute forms in the disposal zone. • SRS will store the Melt-Dilute disposal forms in a dry environment for an indefinite period until resolution of the radioactivity release issue. 		

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Risk ID 22	Origin Date 11/10/97	Rev No. 2	Status Date 07/13/98	Status Active	WBS Element Y.1.7	Subject Area Disposal Form	Functional Area Engineered Barriers	Technology Melt & Dilute
Title Absence of Radioactive Release Requirements for Disposal Form in Disposal Zone							Risk Category D-1: Undefined, incomplete or unclear functional requirements	Risk Facet Technical Performance
Handling Action Transfer							Risk Assessment High	Rank High
Details This risk captures the possibility of a new requirement being imposed upon the SNF disposal form by DOE-RW. Therefore, the risk is transferred to DOE-RW.							Closure Criteria (N/A)	
Estimates for Handling Action Effectiveness (N/A) Success Probability (N/A) Cost (N/A) Start Date (N/A) Completion Date (N/A) Resources Required (N/A)							Fallback Strategy (N/A)	

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Risk ID 23	Origin Date 11/11/97	Rev No. 2	Status Date 07/13/98	Status Active	WBS Element Y.1.7	Subject Area Disposal Form	Functional Area Engineered Barriers	Technology Direct Co-Disposal
Title Absence of Radioactive Release Requirements for Disposal Form in Disposal Zone						Risk Category D-1: Undefined, incomplete or unclear functional requirements		Risk Facet Technical Performance
								Risk Assessment High
Description DOE-RW has not specified requirements pertaining to radioactive release from the Direct Co-Disposal form after emplacement in the disposal zone.						Probability of Risk Very Unlikely		
						Risk Probability Source Team Engineering Judgement		
<p>• For the first 1000 years, there is no need for a requirement. DOE-RW requires the disposal package to "substantially" contain all radioactivity. The project interprets this to mean no radioactivity will escape the disposal package for 1000 years. Because DOE-RW will design the outermost container to meet the "substantial" containment requirement, there is no requirement or impact on the Direct Co-Disposal form.</p> <p>• Between 1000 and 10,000 years, there may be a need for a requirement pertaining to radioactive release rate from the disposal form. For this time period, 10CFR60 gives requirements for radionuclides escaping the repository engineered barrier. Per §60.113(a)(1)(ii)(B), the release rate of any radionuclide "...shall not exceed one part in 100,000 per year of the inventory of that radionuclide calculated to be present at 1,000 years following permanent closure,..." but not exceeding 10CFR20 limits.</p> <p>DOE-RW has not allocated the repository in toto requirements to the various types of DOE SNF disposal forms. The absence of a firm requirement means that design of the Direct Co-Disposal form proceeds at risk.</p> <p>The Direct Co-Disposal form development program will measure radioactive release rates for various disposal environments. A repository performance assessment will use the measured rates to determine if the repository meets the in toto release requirements of 10CFR60 with Direct Co-Disposal forms emplaced.</p> <p>If the repository cannot meet the in toto requirement for radioactive release, a redesign of the Direct Co-Disposal form will be necessary to achieve lower release rates.</p> <p>The relatively high surface area of SNF assemblies within the Direct Co-Disposal form makes this risk greater than the similar risk for the Melt-Dilute disposal form.</p>						Basis The SNF risk assessment team judges the probability of redesign to be very unlikely based on results of preliminary repository performance assessments to date. The preliminary assessments have indicated that the fission products inventory in the Direct Co-Disposal form is so low that an immediate release of 100% of inventory would not exceed dose limits for the general public.		
						An in-depth assessment by subject matter experts will be necessary later to confirm acceptability of the Direct Co-Disposal form design. This assessment must demonstrate that the repository, with Direct Co-Disposal forms emplaced, meets all regulatory requirements.		
Consequence of Risk Critical						Risk Consequence Source Team Engineering Judgement		
Basis The project assumes that redesign of the Direct Co-Disposal form will not be necessary to meet a release rate limit. Instead, three other actions are possible, and any one of them will likely cause overruns exceeding 10%. The three actions are:						• DOE-RW will redesign its waste overpack to be more robust, with ≥ 10,000 year life before breach. Cost burdens will pass to the Direct Co-Disposal option. • DOE-RW will redesign the repository to achieve compliance with the release limit. This could include reducing the number of Direct Co-Disposal forms in the disposal zone. • SRS will store the Direct Co-Disposal forms in a dry environment for an indefinite period until resolution of the radioactivity release issue.		

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Risk ID 23	Origin Date 11/11/97	Rev No. 2	Status Date 07/13/98	Status Active	WBS Element Y.1.7	Subject Area Disposal Form	Functional Area Engineered Barriers	Technology Direct Co-Disposal
Title Absence of Radioactive Release Requirements for Disposal Form in Disposal Zone							Risk Category D-1: Undefined, incomplete or unclear functional requirements	Risk Facet Technical Performance
Handling Action Transfer							Risk Assessment High	Rank High
Details This risk captures the possibility of a new requirement being imposed upon the SNF disposal form by DOE-RW. Therefore, the risk is transferred to DOE-RW.							Closure Criteria (N/A)	
Estimates for Handling Action Effectiveness (N/A) Success Probability (N/A) Cost (N/A) Start Date (N/A) Completion Date (N/A)							Feedback Strategy (N/A)	
Resources Required (N/A)								

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Risk ID 24	Origin Date 11/10/87	Rev No. 1	Status Date 07/13/98	Status Active	WBS Element Y.1.7	Subject Area Disposal Form	Functional Area Engineered Barriers	Technology Melt & Dilute
<p>This Absence of Design Requirements for Disposal Form for 50+ Years Prior to Emplacement</p>							<p>Risk Category D-1: Undefined, incomplete or unclear functional requirements</p>	
<p>Description The project has not specified requirements pertaining to the integrity of the Melt-Dilute disposal form for interim storage, for transportation, and for handling at the repository prior to emplacement in the disposal zone. Instead, the project has assumed that normal design requirements and practices for nuclear component handling and storage will suffice. If this assumption proves later to be invalid, rework of the disposal form could be necessary. Redesign of the manufacturing process could also be required.</p>							<p>Risk Facet Technical Performance Risk Assessment LOW Rank</p>	
<p>Probability of Risk Very Unlikely Basis The SNF risk assessment team judges the probability of rework to be very unlikely based upon extensive experience with similar nuclear canisters. This experience covers contact handling, remote handling, and decades of storage in water environments.</p>							<p>Risk Probability Source Team Engineering Judgement</p>	
<p>Consequence of Risk Negligible Basis Should a canister fail unexpectedly, remedial action would be to replace the canister. Any canister, regardless of design robustness, is vulnerable to failures of various types. The remedial action would open the failed canister, withdraw the disposal form, and seal it within another canister. Remedial action would be a minor threat to cost and schedule, requiring a day or so to complete. No redesign would be necessary.</p>							<p>Risk Consequence Source Team Engineering Judgement</p>	

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Risk ID 24	Origin Date 11/10/97	Rev No. 1	Status Date 07/13/98	Status Active	WRS Element Y.1.7	Subject Area Disposal Form	Functional Area Engineered Barriers	Technology Melt & Dilute
Title Absence of Design Requirements for Disposal Form for 50+ Years Prior to Emplacement							Risk Category D-1: Undefined, incomplete or unclear functional requirements	Risk Facet Technical Performance
Handling Action Accept							Risk Assessment LOW	Rank
State At the present time the project will accept this risk.							Clearance Criteria (N/A)	
Estimates for Handling Action							Fallback Strategy (N/A)	
Effectiveness LOW	Success Probability 100%	Cost (N/A)	Start Date (N/A)	Completion Date (N/A)				
Resources Required (N/A)								

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Risk ID 25	Origin Date 11/10/97	Rev No. 1	Status Date 07/13/98	Status Active	WBS Element Y.1.7	Subject Area Disposal Form	Functional Area Engineered Barriers	Technology Direct Co-Disposal
Title Absence of Design Requirements for Disposal Form for 50+ Years Prior to Emplacement						Risk Category D-1: Undefined, incomplete or unclear functional requirements		Risk Facet Technical Performance
						Risk Assessment Low		Rank
Description The project has not specified requirements pertaining to the integrity of the Direct Co-Disposal form for interim storage, for transportation, and for handling at the repository prior to emplacement in the disposal zone. Instead, the project has assumed that normal design requirements and practices for nuclear component handling and storage will suffice. If this assumption proves later to be invalid, rework of the disposal form could be necessary. Redesign of the manufacturing process could also be required.						Probability of Risk Very Unlikely		
						Risk Probability Source Team Engineering Judgement		
						Consequence of Risk Negligible		
						Risk Consequence Source Team Engineering Judgement		
						Basics The SNF risk assessment team judges the probability of rework to be very unlikely based upon extensive experience with similar nuclear canisters. This experience covers contact handling, remote handling, and decades of storage in water environments.		
						Basics Should a canister fail unexpectedly, remedial action would be to replace the canister. Any canister, regardless of design robustness, is vulnerable to failures of various types. The remedial action would open the failed canister, withdraw the disposal form, and seal it within another canister. Remedial action would be a minor threat to cost and schedule, requiring a day or so to complete. No redesign would be necessary.		

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Risk ID 25	Origin Date 11/10/97	Rev No. 1	Status Date 07/13/98	Status Active	WBS Element Y.1.7	Subject Area Disposal Form	Functional Area Engineered Barriers	Technology Direct Co-Disposal
Risk Category D-1: Undefined, incomplete or unclear functional requirements							Risk Factor Technical Performance	Risk Assessment LOW
Risk Absence of Design Requirements for Disposal Form for 50+ Years Prior to Emplacement							Closure Criteria (N/A)	
Handling Action Accept Beats At the present time the project will accept this risk.								
Estimates for Handling Action							Fallback Strategy (N/A)	
Effectiveness Low	Success Probability 100%	Cost (N/A)	Start Date (N/A)	Completion Date (N/A)				
Resources Required (N/A)								

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SNF Risk Assessment

Risk ID 29	Origin Date 11/11/97	Rev No. 2	Status Date 07/13/98	Status Active	WBS Element Y.1.11	Subject Area Disposal Form	Functional Area Certification per Disposal Criteria	Technology Melt & Dilute
Title Uncertainty in Waste Acceptance Criteria						Risk Category D-1: Undefined, incomplete or unclear functional requirements		Risk Facet Technical Performance
								Risk Assessment Low
Description The MGDS WAC is currently preliminary and does not provide specific limits for various criteria (e.g. - allowable free water in canister, particulate waste forms, pyrophorics, etc.). There is a risk that the Melt-Dilute disposal form will not meet final MGDS WAC requirements.						Probability of Risk Unlikely		
						Risk Probability Source Team Engineering Judgement		
						Consequence of Risk Negligible		
						Risk Consequence Source Team Engineering Judgement		
						Basic Because the current design eliminates free water, particulates, pyrophorics, etc., from the final disposal form, it is unlikely that the Melt-Dilute disposal form will fail to meet final MGDS WAC requirements.		
						Basic If the disposal form fails to meet final MGDS WAC requirements, then a redesign of the disposal form, or the addition of equipment or testing to the manufacturing process, may be required. Impact to the project is estimated to be less than 5% of the life cycle cost or schedule.		

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Risk ID 29	Origin Date 11/11/97	Rev No. 2	Status Date 07/13/98	Status Active	WBS Element Y.1.11	Subject Area Disposal Form	Functional Area Certification per Disposal Criteria	Technology Melt & Dilute
Title Uncertainty in Waste Acceptance Criteria							Risk Category D-1: Undefined, incomplete or unclear functional requirements	Risk Facet Technical Performance
Handling Action Accept							Closure Criteria (N/A)	Risk Assessment LOW
Goals At the present time the project will accept this risk. However, to ensure this remains a Low risk, the project should track MGDS WAC studies scheduled for completion in FY98.								
Estimates for Handling Action Effectiveness LOW Success Probability 100% Cost (N/A) Start Date (N/A) Completion Date (N/A)							Feedback Strategy (N/A)	
Resources Required (N/A)								

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Risk ID 30	Origin Date 11/1/97	Rev No. 2	Status Date 07/13/98	Status Active	WRS Element Y.1.11	Subject Area Disposal Form	Functional Area Certification per Disposal Criteria	Technology Direct Co-Disposal
Title Uncertainty in Waste Acceptance Criteria							Risk Factor Technical Performance	
Description The MGDs WAC is currently preliminary and does not provide specific limits for various criteria (e.g. - allowable free water in canister, particulate waste forms, pyrophorics, etc.). There is a risk that the Direct Co-Disposal form will not meet final MGDs WAC requirements.							Risk Assessment Low	
Risk Category D-1: Undefined, incomplete or unclear functional requirements							Risk Probability Source Team Engineering Judgement	
Probability of Risk Unlikely Because the current design eliminates free water, particulates, pyrophorics, etc., from the final disposal form, it is unlikely that the Direct Co-Disposal form will fail to meet final MGDs WAC requirements.							Consequence of Risk Negligible If the disposal form fails to meet final MGDs WAC requirements, then a redesign of the disposal form, or the addition of equipment or testing to the manufacturing process, may be required. Impact to the project is estimated to be less than 5% of the life cycle cost or schedule.	
Risk Consequence Source Team Engineering Judgement								

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Risk ID 30	Origin Date 11/11/97	Rev No. 2	Status Date 07/13/98	Status Active	WSS Element Y.1.11	Subject Area Disposal Form	Functional Area Certification per Disposal Criteria	Technology Direct Co-Disposal					
<p>Title Uncertainty in Waste Acceptance Criteria</p>							<p>Risk Category D-1: Undefined, incomplete or unclear functional requirements</p>	<p>Risk Factor Technical Performance</p>					
<p>Handling Action Accept</p> <p>Beets At the present time the project will accept this risk. However, to ensure this remains a Low risk, the project should track MGDS WAC studies scheduled for completion in FY98.</p>							<p>Closure Criteria (N/A)</p>	<p>Risk Assessment Low</p>					
<p>Estimates for Handling Action</p> <table border="1"> <tr> <td>Effectiveness Low</td> <td>Success Probability 100%</td> <td>Cost (N/A)</td> <td>Start Date (N/A)</td> <td>Completion Date (N/A)</td> </tr> </table> <p>Resources Required (N/A)</p>							Effectiveness Low	Success Probability 100%	Cost (N/A)	Start Date (N/A)	Completion Date (N/A)	<p>Fallback Strategy (N/A)</p>	
Effectiveness Low	Success Probability 100%	Cost (N/A)	Start Date (N/A)	Completion Date (N/A)									

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Risk ID 31	Origin Date 11/11/97	Rev No. 2	Status Date 07/13/98	Status Active	WBS Element Y.1.12	Subject Area Disposal Form	Functional Area Thermal Performance Considerations	Technology Direct Co-Disposal
Title Peak Clad Temperature Limitation Compliance						Risk Category D-5: Numerous or unclear assumptions		Risk Facet Technical Performance Risk Assessment High
Description Loaded canisters must meet a locally imposed peak cladding temperature limit of 250°C for interim storage. In addition, the MGDS WAC imposes a peak cladding temperature limit of 350°C for SNF loaded in "multi-element canisters that will not be unloaded prior to emplacement." (Ref. 9, Criterion 2.4.21). Currently, there are no analyses to demonstrate compliance with either requirement. There is a risk that this temperature limit may not be met.						Probability of Risk Very Unlikely Risk Probability Source Team Engineering Judgement		
						Basis The low thermal power of the DOE SNF and the ability to "mix-and-match" low and high thermal power elements makes it very unlikely that the canistered SNF will challenge the temperature limits.		
						Consequence of Risk Critical Risk Consequence Source Team Engineering Judgement		
						Basis Possible consequences for the Direct Co-Disposal form are: <ul style="list-style-type: none"> • Limit amount of SNF loaded in canister. • Additional controls may be required during canister loading (hot elements -vs- cold elements). Because of the potential for reduced loading in the Direct Co-Disposal form, the impacts of these consequence are expected to be greater than 10% of the project life cycle cost.		

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Risk ID	Origin Date	Rev No.	Status Date	Status	WBS Element	Subject Area	Functional Area	Technology
31	11/11/97	2	07/13/98	Active	Y.1.12	Disposal Form	Thermal Performance Considerations	Direct Co-Disposal
Title Peak Clad Temperature Limitation Compliance							Risk Category D-5: Numerous or unclear assumptions	Risk Facet Technical Performance
							Risk Assessment High	Rank
Handling Action Mitigate							Closure Criteria (TBD)	
Steps Mitigation strategies include: <ul style="list-style-type: none">• Complete thermal analysis to show compliance with the 250°C limit.• Address the 350°C limit if necessary.								
Estimates for Handling Action							Fallback Strategy (TBD)	
Effectiveness Low	Success Probability 75%	Cost (TBD)	Start Date (TBD)	Completion Date (TBD)				
Resources Required (TBD)								

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Risk ID 32	Origin Date 12/09/97	Rev No. 1	Status Date 07/13/98	Status Active	WSS Element Y.1.8	Subject Area Disposal Form	Functional Area Radiation Shielding	Technology Direct Co-Disposal
<p>Title Meeting Self Protection Requirements</p>							<p>Risk Category D-1: Undefined, incomplete or unclear functional requirements</p>	<p>Risk Facet Technical Performance</p>
<p>Description The TSS Preconceptual Design Report imposes a self protection requirement that radiation from SNF disposal forms must exceed 100 rem/hr at a distance of 0.9 meters (Ref. 4, § 3.1.2.2.8). Lacking detailed radiation analyses, it is assumed that the SNF Direct Co-Disposal form will meet this self protection requirement. There is a risk that some fuel elements will not meet HEU self-protection requirements.</p>							<p>Probability of Risk Likely</p> <p>Risk Probability Source Team Engineering Judgement</p> <p>Basis Because of low burnup or long cooling periods, it is likely that the Direct Co-Disposal form will not meet the 100 rem/hr. self-protection requirement.</p>	<p>Risk Assessment Moderate</p> <p>Rank</p>
							<p>Consequence of Risk Negligible</p> <p>Risk Consequence Source Team Engineering Judgement</p> <p>Basis If self protection requirements cannot be met, then additional security system enhancements will be required for the loaded canister storage area in the TSS. It is estimated that these changes could be implemented with less than a 5% impact on project life cycle cost and schedule.</p>	

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Risk ID 32	Origin Date 12/09/87	Rev No. 1	Status Date 07/13/98	Status Active	WBS Element Y.1.8	Subject Area Disposal Form	Functional Area Radiation Shielding	Technology Direct Co-Disposal	
Title Meeting Self Protection Requirements				Risk Category D-1: Undefined, incomplete or unclear functional requirements		Risk Facet Technical Performance Risk Assessment Moderate		Rank	
Handling Action Mitigate Basis Add security features as required by 10CFR73.				Closure Criteria (TBD)					
Estimates for Handling Action Effectiveness Low				Success Probability 100%		Cost (TBD)		Start Date (TBD)	
Completion Date (TBD)				Feedback Strategy (TBD)					
Resources Required (TBD)									

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Risk ID 33	Origin Date 12/09/97	Rev No. 1	Status Date 07/13/98	Status Active	WBS Element X.0	Subject Area Manufacturing Facility	Functional Area Project Management	Technology Direct Co-Disposal
Title Performance of R&D on Project Critical Path					Risk Category D-5: Numerous or unclear assumptions or modification basis.			
Description R&D for the SNF disposal form and for the manufacturing facility are on or near the project's critical path. It is assumed that completion of R&D can occur within the normal project schedule. There is risk that normal R&D iterations can invalidate this assumption.					Risk Facet Programmatic High			
					Risk Probability Source Team Engineering Judgement			
					Consequence of Risk Critical Normal R&D iterations can have severe negative impacts on project cost and schedule. For the Co-Disposal alternative, impact is expected to be more on project schedule rather than cost.			
					Risk Consequence Source Team Engineering Judgement			

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Risk ID 33	Origin Date 12/09/97	Rev No. 1	Status Date 07/13/98	Status Active	WBS Element X.0	Subject Area Manufacturing Facility	Functional Area Project Management	Technology Direct Co-Disposal
Title Performance of R&D on Project Critical Path				Risk Category D-5: Numerous or unclear assumptions or modification basis.		Risk Facet Programmatic		Risk Assessment High
Handling Action Mitigate				Closure Criteria (TBD)				
Basis The project has been phased so that there is a design only project followed by a construction project. This will limit the financial liability that could be incurred if the R&D does not support the project assumptions. Additionally, the R&D efforts have been prioritized to focus early work on the most likely areas of concern.								
Estimates for Handling Action Effectiveness Moderate				Success Probability 100%	Cost (TBD)	Start Date (TBD)	Completion Date (TBD)	Feedback Strategy (TBD)
Resources Required (TBD)								

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Risk Assessment Database -- Deleted Records

Risk ID	Title	Technology	WBS Element	Subject Area / Functional Area	Page
06	Disposition of Scrap Waste	Melt & Dilute	X.2.2	Manufacturing Facility / Characterization	A-55
07	Disposition of Scrap Waste	Direct Co-Disposal	X.2.2	Manufacturing Facility / Characterization	A-56
08	Identification of LEU Limits	Melt & Dilute	X.2.4	Manufacturing Facility / Packaging	A-57
12	Non-Fuel Products Received in SNF	Direct Co-Disposal	X.2.4	Manufacturing Facility / Packaging	A-58
15	Confinement Versus Containment of Melt-Dilute Furnace Cell	Melt & Dilute	X.2.12	Manufacturing Facility / Furnace Melt & Dilute	A-59
19	Treating HLW Materials from Off Gas System to Meet Acceptance Criteria	Melt & Dilute	X.2.13	Manufacturing Facility / Off Gas System	A-60
26	Imposed Self Protection Requirements	Melt & Dilute	Y.1.8	Disposal Form / Radiation Shielding	A-61
27	Meeting Self Protection Requirements	Melt & Dilute	Y.1.8	Disposal Form / Radiation Shielding	A-62
28	Uncertainty Regarding Disposal Form Classification	Melt & Dilute	Y.1.11	Disposal Form / Certification per Disposal Criteria	A-63

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Risk ID 06	Origin Date 11/12/97	Rev No. 1	Status Date 12/09/97	Status Deleted	WBS Element X.2.2	Subject Area Manufacturing Facility	Functional Area Characterization	Technology Melt & Dilute
Title Disposition of Scrap Waste						Risk Category I-1: Multiple system interfaces.		Risk Facet Disposition
								Risk Assessment Low
Description Disposition of non-fuel (scraps) waste forms which are <u>not</u> classified as high level waste is currently undefined. The project assumes that these wastes can be handled with existing SRS processes. There is a risk that some unforeseen scrape waste may be received that existing SRS processes cannot handle. 12/9/97 The risk assessment team does not anticipate the receipt or generation of any non-fuel scrap waste which will not be included in the Melt-Dilute waste form. Consequently, this risk was deleted from the assessment.						Probability of Risk Unlikely		Risk Probability Source Team Engineering Judgement
						Basis A review of all fuel types has not revealed any non-fuel scrap which cannot be handled by existing SRS processes.		
						Consequence of Risk Negligible		Risk Consequence Source Team Engineering Judgement
						Basis If the scrap non-fuel waste does not meet the acceptance criteria of existing SRS processes, a process modification within this project would be required. This could include a new mission scope for the Melt-Dilute system to include processing this material. Life cycle cost and schedule impacts for this new mission scope should not exceed 5% of the estimate.		

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SNF Risk Assessment

Risk ID 07	Origin Date 11/12/97	Rev No. 1	Status Date 12/09/97	Status Deleted	WBS Element X.2.2	Subject Area Manufacturing Facility	Functional Area Characterization	Technology Direct Co-Disposal
Title Disposition of Scrap Waste						Risk Category I-1: Multiple system interfaces.		Risk Facet Disposition
						Risk Assessment Low		Rank
Description Disposition of non-fuel (scraps) waste forms which are <u>not</u> classified as high level waste is currently undefined. The project assumes that these wastes can be handled with existing SRS processes. There is a risk that some unforeseen scrap waste may be received that existing SRS processes cannot handle.						Probability of Risk Unlikely		
						Risk Probability Source Team Engineering Judgement		
Basis A review of all fuel types has not revealed any non-fuel scrap which cannot be handled by existing SRS processes.								
12/9/97								
The risk assessment team does not anticipate the receipt or generation of any non-fuel scrap waste which will not be included in the Direct Co-Disposal waste form. Consequently, this risk was deleted from the assessment.								
						Consequence of Risk Negligible		
						Risk Consequence Source Team Engineering Judgement		
						Basis If the scrap non-fuel waste does not meet the acceptance criteria of existing SRS processes, a process modification within this project would be required. This could include a new mission scope for the Direct Co-Disposal system to include processing this material. Life cycle cost and schedule impacts for this new mission scope should not exceed 5% of the estimate.		

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SNF Risk Assessment

Risk ID 08	Origin Date 11/12/97	Rev No. 1	Status Date 12/09/97	Status Deleted	WBS Element X.2.4	Subject Area Manufacturing Facility	Functional Area Packaging	Technology Melt & Dilute
Title Identification of LEU Limits						Risk Category D-1: Undefined, incomplete or unclear functional requirements.		Risk Facet Technical Performance
								Risk Assessment Low
Description SRS is designing the Melt-Dilute disposal form to contain < 20% ²³⁵ U. It is assumed that the disposal form will meet the MGDS WAC requirement for $k_{eff} \leq 0.95$ throughout the disposal zone. There is a risk that future repository performance assessments could invalidate this assumption and require lower ²³⁵ U contents.						Probability of Risk Very Unlikely		Risk Probability Source Team Engineering Judgement
Basis The total fissile material which this project adds to the repository is small and contributes very little to the total repository k_{eff} . Under these conditions, it is very unlikely that a ²³⁵ U reduction will be necessary.								
12/9/97 The risk assessment team did not believe this to be a valid risk since the final dilution levels for the Melt-Dilute disposal form have yet to be determined. The final dilution level will be established based upon criticality studies either ongoing or planned. Other criticality concerns are covered by Risk ID 20. Consequently, this risk was deleted from the assessment.						Consequence of Risk Negligible		Risk Consequence Source Team Engineering Judgement
						Basis Should LEU limits differ from anticipated, the facility will be required to add more canister disposal forms during operations. This could result in longer facility operating periods, more canisters, and higher costs for interim storage and repository disposal. This is expected to have less than a 5% impact on life cycle cost and schedule.		

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Risk ID 12	Origin Date 11/12/97	Rev No. 1	Status Date 12/09/97	Status Deleted	WBS Element X.2.4	Subject Area Manufacturing Facility	Functional Area Packaging	Technology Direct Co-Disposal
Title Non-Fuel Products Received in SNF						Risk Category R/E-2: Additional releases.		Risk Facet Technical Performance Risk Assessment Low Rank
Description There may be some unknown non-fuel related materials received in the SNF which could result in a disposal form which is unacceptable to the repository. The current TSS design will detect a range of anticipated non-fuel materials and disposition these unacceptable materials. There is a risk that the current design cannot detect all non-fuel materials, and consequently, the process would not be pre-certified by DOE-RW. 12/9/97 The risk assessment team judged this risk to be non-credible due to the characterization of incoming SNF inventories. Consequently, this risk was deleted from the assessment.						Probability of Risk Very Unlikely Risk Probability Source Team Engineering Judgement Basis The characterization station for the Direct Co-Disposal option has an extensive examination of SNF. With this examination of SNF, it is very unlikely that non-fuel materials could escape detection and be packaged in the final disposal form.		
						Consequence of Risk Negligible Risk Consequence Source Team Engineering Judgement Basis The facility may produce one or two of these unacceptable disposal forms during the operating lifetime. These disposal forms would be handled and dispositioned on an ad hoc basis with minimal impact on the facility life cycle cost and schedule.		

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SNF Risk Assessment

Risk ID 15	Origin Date 11/12/97	Rev No. 1	Status Date 12/09/97	Source Deleted	WBS Element X.2.12	Subject Area Manufacturing Facility	Functional Area Furnace Melt and Dilute	Technology Melt & Dilute
Title Confinement Versus Containment of Melt-Dilute Furnace Cell						Risk Category S-3: New Design Basis Accident or other USQ.		Risk Facet Safety Risk Assessment Low Rank
Description <p>The current design for furnace cell uses a confinement approach instead of containment. The confinement approach uses (1) an off gas system to capture radioactivity that releases directly from the melted SNF, and (2) once-through air ventilation system with filtration and traps in the exhaust stream to capture any leaked radioactivity before ventilation air release to the environment. The current design does not yet have a systematic safety analysis to demonstrate acceptability of the confinement approach for normal, off-normal and accident conditions involving the furnace process.</p> <p>There is a risk that an unforeseen design basis accident or other unresolved safety question could overcome the confinement design and force the use of a containment approach. Such a swing could have serious impacts on technical scope, operating philosophy, cost and schedule.</p> <p>12/9/97</p> <p>The Melt-Dilute process, as currently designed, will be inside a cell and will have confinement inside the cell. The fuel assemblies will be diluted with depleted uranium metal to reduce the enrichment. If cesium is released from the metal during operations, it will deposit inside the cell on the walls. This would necessitate clean up of the cell, and these concerns are part of the current design.</p> <p>Based upon extensive SRS experience with nuclear processes, the risk assessment team believed it unreasonable to expect that a containment, versus confinement, system would be mandated for the Melt-Dilute process. Consequently, this risk was deleted from the assessment.</p>						Probability of Risk Unlikely Risk Probability Source Team Engineering Judgement Basis The industry has considerable experience with melting aluminum-based materials. This experience covers furnace normal operations and accident conditions. With this considerable experience, designers have not foreseen an accident beyond the capabilities of a confinement system.		
						Consequence of Risk Negligible Risk Consequence Source Team Engineering Judgement Basis Impacts will be significant but not serious if the design must switch to a containment concept. Containment design concepts are well established, and would only require adaptation to the melt-dilute cell. Estimated cost and schedule increase would be 5% or less.		

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SNF Risk Assessment

Risk ID 19	Origin Date 11/12/97	Rev No. 1	Status Date 12/09/97	Status Deleted	WBS Element X.2.13	Subject Area Manufacturing Facility	Functional Area Off Gas System	Technology Melt & Dilute
Title Treating HLW Materials from Off Gas System to Meet Acceptance Criteria						Risk Category T-3: New application of existing technology.		Risk Facet Technical Performance
						Risk Assessment High		Rank
Description <p>Handling is undefined for HLW materials cleaned from the walls of the off gas system. The handling options are twofold: 1) placement within the SNF disposal form canisters, or 2) transfer to the HLW tank farm for eventual vitrification by DWPF.</p> <p>Whichever handling option the project chooses, the HLW materials form and concentration will likely require treatment to meet the option's acceptance criteria. Neither the handling option's acceptance criteria nor the treatment process is defined at this time. The project assumes that a treatment process, when defined, can be included with minimal impacts to current design. There is a risk that a treatment process with first-of-a-kind features will be required which could invalidate the assumption.</p> <p>1) The treatment system could be first-of-a-kind. Extensive research and development might be necessary to prove the process, adding significant cost and schedule to the project.</p> <p>2) Adding a treatment process to the project scope could seriously impact cost and schedule, even if it is a conventional, proven process.</p> <p>12/9/97</p> <p>At one time option 1) was a possibility, but because of uncertainties with regard to compliance with the MGDS WAC, it is no longer being considered. The risk assessment team felt concerns with regard to option 2) were adequately addressed by Risk ID 16. Consequently, this risk was deleted from the assessment.</p>						<p>Probability of Risk Very Unlikely</p> <p>Risk Probability Source Team Engineering Judgement</p> <p>Basis The industry has considerable experience with nuclear materials treatment processes. This experience makes it very unlikely that extensive R&D will be necessary to meet reasonable acceptance criteria. Although the treatment processes may have some first-of-a-kind features, only minor extrapolations from proven concepts are likely to be necessary. The cost and schedule burden from these minor extrapolations are very unlikely to cause major problems.</p>		
						<p>Consequence of Risk Critical</p> <p>Risk Consequence Source Team Engineering Judgement</p> <p>Basis Impacts could be serious if the treatment process has substantial first-of-a-kind features. Extensive research and development might be necessary to prove the process, adding significant cost and schedule to the project.</p> <p>Impacts could also be serious for conventional treatment processes. The definition of the fission products, their chemical state, the SRS HLW acceptance criteria, and the treatment process design will occur so late in the project cycle that impacts will be significant for cost and schedule.</p>		

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SNF Risk Assessment

Risk ID 26	Origin Date 11/10/97	Rev No. 1	Status Date 12/09/97	Status Deleted	WDS Element Y.1.8	Subject Area Disposal Form	Functional Area Radiation Shielding	Technology Melt & Dilute
Title Imposed Self Protection Requirements						Risk Category D-1: Undefined, incomplete or unclear functional requirements		Risk Facet Technical Performance
								Risk Assessment Low
Description The Melt-Dilute disposal form may not meet the self protection requirement of 100 rem/hr at a distance of 0.9 meters (Ref. 4, § 3.1.2.2.8). It is assumed that DOE-RW will not impose this requirement on the canistered SNF received at the repository. Instead DOE-RW will avoid the need for extensive physical security at the repository by building a primary disposal form with HLW vitrified waste which will meet this self protection requirement. There is a risk that DOE-RW will impose the self protection requirement on the canistered SNF disposal form.						Probability of Risk Unlikely		Risk Probability Source Team Engineering Judgement
12/9/97						Basis The SNF risk assessment team judges the probability to be unlikely that DOE-RW will impose this requirement on the Melt-Dilute disposal form because this form is LEU.		
The risk assessment team judged this risk to be non-credible for the following reasons:						Consequence of Risk Negligible		Risk Consequence Source Team Engineering Judgement
<ul style="list-style-type: none"> the MGDS WAC does not currently require self protection for DOE SNF, and there is no reason to believe that regulations will be mandated to impose that requirement; the Melt-Dilute disposal form will always be diluted to LEU such that self protection for non-proliferation is not required. 						Basis DOE-RW may need to add security to the disposal facility site to ensure non-proliferation. This additional security will increase the disposal fee, estimated to be less than 5% of the life cycle cost for canistered SNF.		
Consequently, this risk was deleted from the assessment.								

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SNF Risk Assessment

Risk ID 27	Origin Date 11/10/97	Rev No. 1	Status Date 12/09/97	Status Deleted	WBS Element Y.1.8	Subject Area Disposal Form	Functional Area Radiation Shielding	Technology Melt & Dilute
Title Meeting Self Protection Requirements						Risk Category D-1: Undefined, incomplete or unclear functional requirements		Risk Facet Technical Performance Risk Assessment Moderate Rank
Description The TSS Preconceptual Design Report imposes a self protection requirement that radiation from SNF disposal forms must exceed 100 rem/hr at a distance of 0.9 meters (Ref. 4, § 3.1.2.2.8). Lacking detailed radiation analyses, it is assumed that the SNF Melt-Dilute disposal form will meet this self protection requirement. There is a risk that the off gas system will remove activation and fission products to the extent that this radiation level will not be met. 12/9/97 The risk assessment team judged this risk to be non-credible for the following reasons: <ul style="list-style-type: none"> the MGDS WAC does not currently require self protection for DOE SNF, and there is no reason to believe that regulations will be mandated to impose that requirement; the Melt-Dilute disposal form will always be diluted to LEU such that self protection for non-proliferation is not required. Consequently, this risk was deleted from the assessment.						Probability of Risk Likely Risk Probability Source Team Engineering Judgement Basis Because the off gas system will remove significant quantities of radioactive materials, it is likely that this disposal form will not meet the 100 rem/hr. requirement.		
						Consequence of Risk Negligible Risk Consequence Source Team Engineering Judgement Basis Either the disposal form or the furnace process could be redesigned to add or retain more radiation materials to meet self protection requirements (such as putting Cs back into the product or keeping it from off gassing in the process). If self protection requirements cannot be met, then additional security system enhancements will be required. It is estimated that these changes could be implemented with less than 5% impact on life cycle cost and schedule.		

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SNF Risk Assessment

Risk ID 28	Origin Date 11/10/97	Rev No. 1	Status Date 12/09/97	Status Deleted	WBS Element Y.1.11	Subject Area Disposal Form	Functional Area Certification per Disposal Criteria	Technology Melt & Dilute
Title Uncertainty Regarding Disposal Form Classification						Risk Category D-1: Undefined, incomplete or unclear functional requirements		Risk Facet Technical Performance
								Risk Assessment Low
Description According to the MGDS WAC, SNF is defined as "...fuel that has been withdrawn from a nuclear reactor following irradiation, the constituent elements of which have not been separated by reprocessing." The design approach assumes that the Melt-Dilute disposal form will still be classified as SNF, and that the certification criteria for SNF will apply. There is a risk that the Melt-Dilute disposal form will not be classified as SNF after it has gone through the proposed disposal form process. If the disposal form is not classified as SNF, but is instead classified as HLW, then it is assumed that existing ASTM standards and the MGDS WAC for HLW apply, and that those standards and criteria are no more rigorous than those for SNF or vitrified HLW. There is a contingent risk that if the disposal form is classified as non-vitrified HLW, the Melt-Dilute process may have to be changed to accommodate more rigorous standards and/or criteria. 12/8/97 The risk assessment team judged this risk to be non-credible since the Melt-Dilute process does not alter the constituents of the U-AI SNF. Consequently, this risk was deleted from the assessment (Ref. Assumption 3).						Probability of Risk Very Unlikely		Risk Probability Source Team Engineering Judgement
						Basis Because SNF is not reprocessed during the Melt-Dilute process, the probability is very unlikely that the Melt-Dilute disposal form will not be classified as SNF.		
						Consequence of Risk Negligible		Risk Consequence Source Team Engineering Judgement
						Basis If the Melt-Dilute disposal form was not classified as SNF, then it would be classified as either LLW or HLW. In either case, the site has extensive experience in dealing with those classifications of wastes.		