Savannah River Site

High Level Waste Salt Disposition Systems Engineering Team

Decision Phase Final Report (U)

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HLW Salt Disposition Systems Engineering Team
Decision Phase Final Report

Approved By: ________________________________ ________________

S. F. Piccolo, HLW Salt Disposition Program Manager **Date**

DISCLAIMER

REVISION SUMMARY

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Abstract

This report describes the process used and results obtained by the High Level Waste (HLW) Salt Disposition Systems Engineering Team (Team) to recommend a path forward for salt disposition at the Savannah River Site (SRS). The selection of an alternative salt disposition technology is necessary as the existing In Tank Precipitation (ITP) process cannot simultaneously meet the HLW system production and safety requirements. The SRS high level salt solution waste must be immobilized for final disposition in support of environmental protection, safety, and current and planned missions. The Team concluded that the alternative most technically suited for processing SRS high level salt solution waste within the constraints of the Federal Facilities Agreement (FFA), Site Treatment Plan (STP), SRS Tank Farm Salt/Space Management, HLW System, and DWPF interfaces is Small Tank Tetraphenylborate (TPB) Precipitation. The Team also concluded that from a DOE complex and business perspective, the Crystalline Silicotitanate (CST) Non-Elutable Ion Exchange alternative could show significant promise. With the appropriate level of research and management attention, CST Non-Elutable Ion Exchange could effectively serve the DOE complex and result in complex wide savings for technology development. CST Non-Elutable Ion Exchange can also be effectively applied to SRS waste, although with a higher project implementation risk than Small Tank TPB Precipitation.

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1.0 Executive Summary

This section provides a summary of the decision process utilized to recommend a HLW salt disposition path forward based on the HLW Salt Disposition Systems Engineering Team Decision Phase activities.

1.1 Charter

Westinghouse Savannah River Company (WSRC) completed a systems engineering evaluation of HLW salt disposition alternatives in October 1998 (Reference 7). The U.S. Department of Energy (DOE) – Savannah River Operations Office (SR) completed their review of the systems engineering process and recommendations on January 25, 1999 (Reference 9). The conclusions of their review and a proposed path forward were forwarded to the DOE Assistant Secretary for Environmental Management (EM-1). EM-1 provided authorization to proceed with the DOE-SR proposed path forward. DOE authorized initiation of a Supplemental Environmental Impact Statement in parallel with performance of additional research on the CST Non-Elutable Ion Exchange and Small Tank TPB Precipitation technologies to address defined technical uncertainties, evaluation of tank farm salt/space management practices, selected trade studies, and additional evaluation of the regulatory/public acceptance for cesium disposal in grout.

1.2 Decision Phase

The Decision Phase was entered into as a continuation of the HLW Salt Disposition Systems Engineering Team efforts of 1998. The Team subjected the four short list alternatives from the 1998 Selection Phase (Caustic Side Solvent Extraction, CST Non-Elutable Ion Exchange, Direct Disposal in Grout, and Small Tank TPB Precipitation) to the decision process. The four alternatives were included because the Decision Phase is a continuation of the Selection Phase and each process had technical merit. Research and Development (R&D) was conducted on CST Non-Elutable Ion Exchange and Small Tank TPB Precipitation consistent with the DOE-SR Management Plan. A more limited amount of R&D was performed on Caustic Side Solvent Extraction and Direct Disposal in Grout. Each alternative also had some advancement in technology understanding. The decision process tools would be the same tools used in the 1998 Team activities, therefore adding results comparison validity. A decision logic was developed factoring in those attributes highlighted as issues in the WSRC Final Report, WSRC-RP-98-0170, DOE-SR Review Team Final Report, letter to James M. Owendoff dated December 16, 1998, and the Independent Project Evaluation Team Review and Assessment Report, DOE/ID-10672. Science and technology activities were performed to advance understanding for those technical uncertainties which could potentially provide technical discrimination between the alternatives. This work has been completed, and the results applied to the decision process.

The Decision Phase selection process was baselined against the HLW Salt Disposition Systems Engineering Team's 1998 results. The decision process characterized substantive deltas in uncertainties, risks, Life Cycle Costs (LCCs), and weighted scores for the Short List alternatives. The decision process also provided a qualitative cross-check of the decision results versus the expected conclusions from the delivered research.

1.3 Team Members and External Input

Decision Phase Team members were chosen to provide expertise in Program Management, Systems Engineering, Process Engineering, Operations, Research and Development, Safety Management, and Technology Integration. Members were selected to provide a strong linkage to and knowledge of the fiscal year 1998 Selection process and information. Significant WSRC engineering resources were dedicated to and managed by the Team, as was an administrative support staff. Research and Development activities were lead by the Savannah River Technology Center (SRTC), with participation from the Oak Ridge and Argonne National Laboratories, and vendor representatives.

The Team's efforts have been conducted with regular interactions with the Independent Project Evaluation (IPE) Team and the Citizen's Advisory Board (CAB) members and included a technology information exchange with Hanford. Additionally, the National Academy of Science/National Research Council held a public meeting to review the technology selection process and provided observations in a interim letter-report (reference 15). The associated input from these sources has been accommodated/addressed in this report.

1.4 Results

The Team concluded that the most suited technology for processing SRS high level salt solution waste within the constraints of the Federal Facilities Agreement (FFA), Site Treatment Plan (STP), SRS Tank Farm Salt/Space Management, HLW System, and DWPF interfaces is Small Tank TPB Precipitation. The research conducted has confirmed most of the targeted uncertainties in a positive nature, thus reducing the "effective" risk, and "effective" uncertainties associated with project implementation relative to its position at the end of the 1998 Selection Phase.

The safety issues raised regarding TPB decomposition in the process have been addressed in the pre-conceptual design. The process includes positive pressure nitrogen inerting and secondary confinement of the process vessels. In addition, the stainless steel small tank design, with its shorter processing time, minimizes the product stability issues while achieving the desired salt solution decontamination factor (DF). The Team evaluated processing uncertainties related to bounding catalyst activation, foam formation, and TPB recovery, which require additional R&D demonstration prior to proceeding with detail design.

A focused economic evaluation regarding moving the precipitate hydrolysis process to the Small Tank TPB Precipitation Facility was conducted since the "High Level Waste Tank Space Management Team Final Report" (Reference 2) recommended a strategy which included placing an evaporator in the DWPF Salt Processing Cell. Based on the study and further technical evaluation, the Team concluded that the precipitate hydrolysis process should be included in the new facility. This approach supports the Tank Farm Salt/Space Management strategy, provides for benzene management in a single-purpose built facility and increased the facility throughput equal to the other alternatives. The net result was that an approximately $80M additional capital investment would result in over $950M life cycle cost savings.

The Team also recognizes that from a DOE complex perspective, the CST Non-Elutable Ion Exchange alternative exhibits potential benefits. The research conducted on the targeted uncertainties suggest more development of the CST resin is needed to support application with SRS high level salt solution waste. The Team assessed uncertainties related to cesium desorption, resin stability, solids formation, and DWPF interface. The Team believes that these issues can be resolved with the appropriate level of research industry involvement and management attention and result in complex wide savings for technology development. The material stability research would need to be brought to favorable conclusion prior to proceeding with design. The net result on the engineered resolutions was an increase in project costs and life cycle costs. The R&D effort resulted in an increase in "effective" risk and "effective" uncertainty for project implementation relative to its position at the end of the 1998 Selection Phase.

The Team concluded through the evaluation process that the Direct Disposal in Grout alternative should not be considered. The reasoning for arriving at this decision is primarily the non-technical programmatic risks. Additionally, current R&D confirms the technology risk associated with MST use. The recommended alternative must have a sure path to operation by 2010 and the closure of the SRS HLW Tanks in accordance with the FFA and STP commitments. The Team knows of no mitigation strategy that would assure that the facility could be commissioned, and that NRC, SCDHEC, and EPA approvals could be obtained, and likely court cases resolved in a manner compatible with this schedule. Although acceptably passing the performance assessment requirements, the Team felt that public acceptance would be more difficult than originally anticipated based on recent interaction with the Citizens Advisory Board. The three sequential risks of regulatory approval, political approval, and judicial approval, all of which have been seen in similar instances, could not be resolved on the necessary schedule with any mitigation strategy the Team could devise.

It should also be noted that the Team recognized favorable attributes with Caustic Side Solvent Extraction. The limited recent research had positive results, but was not sufficient to change the "effective" risk and "effective" uncertainty regarding project implementation as was concluded in the "HLW Salt Disposition System Engineering Team Final Report" (Reference 7). The relative immaturity of the solvent system was the major deciding factor. Positive attributes associated with this technology were operational, mission and operating schedule flexibility. Additionally, solvent extraction has other development opportunities within the DOE complex and may warrant DOE pursuit of the calixerene science development.

A focused technical and economic evaluation of the current design and plausible alternatives for the removal of uranium, plutonium, neptunium, and strontium from the HLW salt solutions was conducted in accordance with "Position Paper on the Approach to Evaluate Using Existing Facilities for Feed Clarification" (Reference 3). Based on the technical limitations of filtering the resultant material, no viable alternative to the existing approach for feed clarification was identified. The results are documented in the "Alternative for Feed Clarification Study" (Reference 4).

1.5 Recommended Path Forward

WSRC recommends that the Small Tank TPB Precipitation be pursued as the most suited technology for SRS high level salt solution waste processing. Investigation should continue into the understanding of catalyst activation and foaming to disposition these key risks. WSRC also recommends that more detailed evaluations and studies for reuse of existing facilities and alternative unit operation technology be performed. R&D should also continue on the CST Non-Elutable Ion Exchange alternative to address cesium desorption, resin stability, material transport and sampling, and MST filtration risks.

A second option considers the broader DOE complex perspective. This approach would proceed with an aggressive R&D program solely for the CST Non-Elutable Ion Exchange alternative. The R&D would focus on cesium desorption, resin stability, and re-engineering risks with additional effort to pursue material transport and sampling, MST resuspension and filtration, facility interface issues, and glass qualification. Limited R&D efforts to further reduce targeted risk for the Small Tank TPB Precipitation process would continue.

2.0 Introduction and Purpose

The Savannah River Site (SRS) Site Treatment Plan (STP) and Federal Facilities Agreement (FFA) call for closing the HLW Tanks through vitrification of both the long-lived and short-lived radioisotopes in DWPF in preparation for transport to the national high level waste repository. To make this program economically feasible, it is necessary to limit the volume of HLW glass produced by removing much of the non-radioactive salts and incidental wastes for disposal as saltstone. The ITP facility was designed and constructed to separate the cesium isotopes from the non-radioactive salts so the decontaminated salts could be disposed in a grouted wasteform at the Saltstone facility at SRS.

The ITP process was successfully piloted both on a moderate and full-scale basis with actual SRS waste in the 1980s. During the facility radioactive startup, higher than predicted benzene releases were observed. Additional laboratory and facility tests were initiated to further investigate process chemistry issues. In January 1998, conclusions were drawn from the test program that the benzene release rates associated with facility operation could exceed the capability of the current plant hardware/systems. On January 22, 1998, WSRC informed DOE that ITP chemistry testing demonstrated that the present system configuration could not cost-effectively meet the safety and production requirements for the ITP facility and recommended that a study of alternatives to the current system configuration be conducted by a systems engineering team.

On February 6, 1998, the Assistant Secretary for Environmental Management approved a DOE-SR plan of action to suspend startup-related activities and undertake a systems engineering study of alternatives to ITP. On February 20, 1998, DOE-SR concurred with the WSRC evaluation of the ITP chemistry data, instructed WSRC to suspend ITP startup preparations, and directed WSRC to perform an evaluation of alternatives to the current system configuration for HLW salt removal, treatment, and disposal.

In March 1998, a WSRC-sponsored High Level Waste Systems Engineering Team was formed to study alternatives to the ITP processes as well as methods to enhance the current process. The multi-disciplined Team was chartered with the task of "systematically developing and recommending an alternative method and/or technology for disposition of HLW salt." The HLW Systems Engineering Team completed the chartered activities, and issued the "HLW Salt Disposition Systems Engineering Team Final Report" (Reference 7) in October 1998.

The U.S. Department of Energy (DOE) – Savannah River Operations Office (SR) completed their review of the WSRC selection process and issued the High Level Waste Salt Disposition Alternatives Evaluation recommendations on January 25, 1999 (Reference 9). The conclusions of their review and a proposed path forward were forwarded to the DOE Assistant Secretary for Environmental Management (EM-1). EM-1 provided authorization to proceed with the DOE-SR proposed path forward. DOE authorized initiation of a Supplemental Environmental Impact Statement in parallel with performance of additional research on the CST Non-Elutable Ion Exchange and Small Tank TPB Precipitation technologies to address defined technical uncertainties, evaluation of tank farm salt/space management practices, selected trade studies, and additional evaluation of the regulatory/public acceptance for cesium disposal in grout.

2.1 Background

High Level Waste has been produced at the SRS since 1951. This waste was stored in Interim Waste Tanks. In the early 1980s, a concept was developed to no longer construct additional Interim Waste Tanks, but to process the waste into a safer storage form, reduce risk, and ready the waste for permanent storage. This led to an initial design concept for DWPF and an Ion Exchange Facility.

The cost for both facilities was high, and technical uncertainties for Ion Exchange posed too high a risk. Alternatives to the Ion Exchange Process were evaluated and the ITP process was selected due to lower projected cost and technical risk.

The Savannah River Site currently stores 34 million gallons of HLW in Interim Storage Tanks. This activity is considered to be one of the higher risk activities on the Site. The FFA requires removing the waste from the high level waste tanks to resolve several safety and regulatory concerns. Tanks have leaked observable quantities of waste from primary to secondary containment. Other tanks have known penetrations above the liquid level, although no waste has been observed to leak through these penetrations. The “old style” tanks do not meet EPA secondary containment standards for storage of hazardous waste, (effective January 12, 1987). The 34 million gallons of waste stored in the HLW tanks are composed of 31 million gallons of “Salt” and 3 million gallons of sludge. The Sludge process is fully operational. The ITP process was the baseline method intended for handling Salt.

During the facility radioactive startup, higher-than-predicted benzene releases were observed, and a program initiated to investigate process chemistry issues. The program concluded that the benzene release rates associated with facility operation could exceed the capability of the current plant hardware/systems. WSRC informed DOE that the present system configuration could not cost-effectively meet the safety and production requirements for the ITP facility and recommended that a study of alternatives to the current system configuration be conducted by a Systems Engineering team.

With the formation of the Team, a DOE-sponsored charter was issued to guide the systems engineering process for determination of a preferred salt disposition technology. The need for a timely decision was identified. The charter indicated the decision should consider impacts to the following: Limited Tank Farm storage capacity, additional DWPF glass canister production, incurred Life Cycle Cost (LCC) and prolonged environmental risk for liquid waste storage.

2.2 High Level Waste System Overview

Any new salt processing system will interface with existing facilities, and the ease or difficulty of the successful implementation of an alternative technology is governed by how well it will integrate into the existing HLW System.

The HLW System is a set of seven different interconnected processes (Figure 2-1) operated by the High Level Waste and Solid Waste Divisions. These processes function as one large treatment plant that receives, stores, and treats high level wastes at SRS and converts these wastes into forms suitable for final disposal.

These processes currently include:

- High Level Waste Storage and Evaporation (F and H Area Tank Farms)
- Salt Processing (In Tank Precipitation and Late Wash Facilities)
- Sludge Processing (Extended Sludge Processing Facility)
- Vitrification (DWPF)
- Wastewater Treatment (Effluent Treatment Facility)
- Solidification (Saltstone Facility)
- Organic Destruction (Consolidated Incineration Facility)

F and H Area Tank Farm, Extended Sludge Processing, DWPF, Effluent Treatment Facility, Saltstone Facility, and the Consolidated Incineration Facility are all operational. ITP Facility operations are limited to safe storage and transfer of materials. The Late Wash Facility has been tested and is in a dry lay-up status.

The mission of the HLW System is to receive and store SRS high level wastes in a safe and environmentally sound manner and to convert these wastes into forms suitable for final disposal. The planned forms are:

- borosilicate glass to be sent to a Federal Repository
- saltstone to be disposed on site
- treated wastewater to be released to the environment.

Also, the storage tanks and facilities used to process the high level waste must be left in a state such that they can be decommissioned and closed in a cost-effective manner and in accordance with appropriate regulations and regulatory agreements.

All high level wastes in storage at SRS are Land Disposal Restrictions wastes, which are prohibited from permanent storage. Since the planned processing of these wastes will require considerable time and therefore continued storage of the waste, DOE has entered into a compliance agreement with the EPA and SCDHEC. This compliance agreement is implemented through the STP, which requires processing of all the high level waste at SRS according to a schedule negotiated between the parties.

Figure 2-1 schematically illustrates the routine flow of wastes through the HLW System. The various processes within the system and external processes are shown in rectangles. The numbered streams identified in italics are the interface streams between the various processes. The discussion below represents the HLW System configuration as of January 1998.

Incoming high level wastes are received into HLW Storage and Evaporation (F and H Area Tank Farms) (Stream 1). The function of HLW Storage and Evaporation is to safely concentrate and to store these wastes until downstream processes are available for further processing. The decontaminated liquid from the evaporators are sent to Wastewater Treatment (ETF) (Stream 13).

The insoluble sludges that settle to the bottom of waste receipt tanks in HLW Storage and Evaporation are slurried using hydraulic slurrying techniques and sent to Extended Sludge Processing (ESP) (Stream 2). In ESP, sludges high in aluminum are processed to remove some of the insoluble aluminum compounds. All sludges, including those that have been processed to remove aluminum, are washed with water to reduce their soluble salt content. The spent washwater from this process is sent back to the HLW Storage and Evaporation (Stream 3). The washed sludge is sent to Vitrification (DWPF) for feed pretreatment and vitrification (Stream 4).

Saltcake is redissolved using hydraulic slurrying techniques similar to sludge slurrying. As currently designed, the salt solutions from this operation, and other salt solutions from HLW Storage and Evaporation, were intended for feed to Salt Processing (Stream 5). In ITP, the salt solution would be processed to remove radionuclides, which are concentrated into an organic precipitate. The decontaminated filtrate would then be sent to Tank 50. A concentrated organic precipitate, containing most of the radionuclides, is produced by the process. This precipitate is washed with water to remove soluble salts. However, some soluble corrosion inhibitors that interfere with DWPF processing must be left in the precipitate after washing because the precipitate is stored in carbon steel tanks, which are susceptible to corrosive attack by uninhibited precipitate wastes.

The precipitate is transferred to Late Wash for further washing in stainless steel tanks to reduce the level of soluble corrosion inhibitors to acceptable levels for the DWPF process (Stream 7). The washwater from this process is returned to ITP to be reused in the ITP process (Stream 8).

The washed precipitate from Late Wash is then sent to the DWPF vitrification building (221-S). In the vitrification building, the precipitate is catalytically decomposed and separated into two streams: a mildly contaminated organic stream and an aqueous stream containing virtually all of the radionuclides. The mildly contaminated organics are stored at DWPF and eventually transferred to Organic Destruction (CIF) (Stream 11). The aqueous stream is combined with the washed sludge from ESP, which has undergone further processing and the mixture vitrified.

The washed sludge from ESP (Stream 4) is chemically adjusted in the DWPF to prepare the sludge for feed to the glass melter. As part of this process, mercury is stripped out, purified, and sent to mercury receivers (Stream 12). The aqueous product from organic decomposition is added to the chemically adjusted sludge. The mixture is then combined with glass frit and sent to the glass melter. The glass melter drives off the water and melts the wastes into a borosilicate glass matrix, which is poured into a canister. The canistered glass wasteform is sent to site interim storage, and will eventually be disposed of in a Federal Repository (Stream 9).

The water vapor driven off from the melter along with other aqueous streams generated throughout the DWPF vitrification building is recycled to HLW Storage and Evaporation for processing (Stream 10).

Overheads from the HLW Storage and Evaporation evaporators are combined with overheads from evaporators in the F and H Area Separations processes and other low-level streams from various waste generators. This mixture of low-level wastes is sent to the ETF (Stream 13).

In the ETF, these low-level wastes are decontaminated by a series of cleaning processes. The decontaminated water effluent is sent to the H Area outfall and eventually flows to local creeks and the Savannah River (Stream 14). The contaminants removed from the water are concentrated and sent to Tank 50 (Stream 15).

In Tank 50, the concentrate from the ETF is combined with the decontaminated filtrate from the ITP and sent to Saltstone (Stream 6). In the Saltstone Facility, the liquid waste is combined with cement formers and pumped as a wet grout to a vault (Stream 16). In the vault, the cement formers hydrate and cure, forming a saltstone monolith. The Saltstone Facility vaults will eventually be closed as a landfill

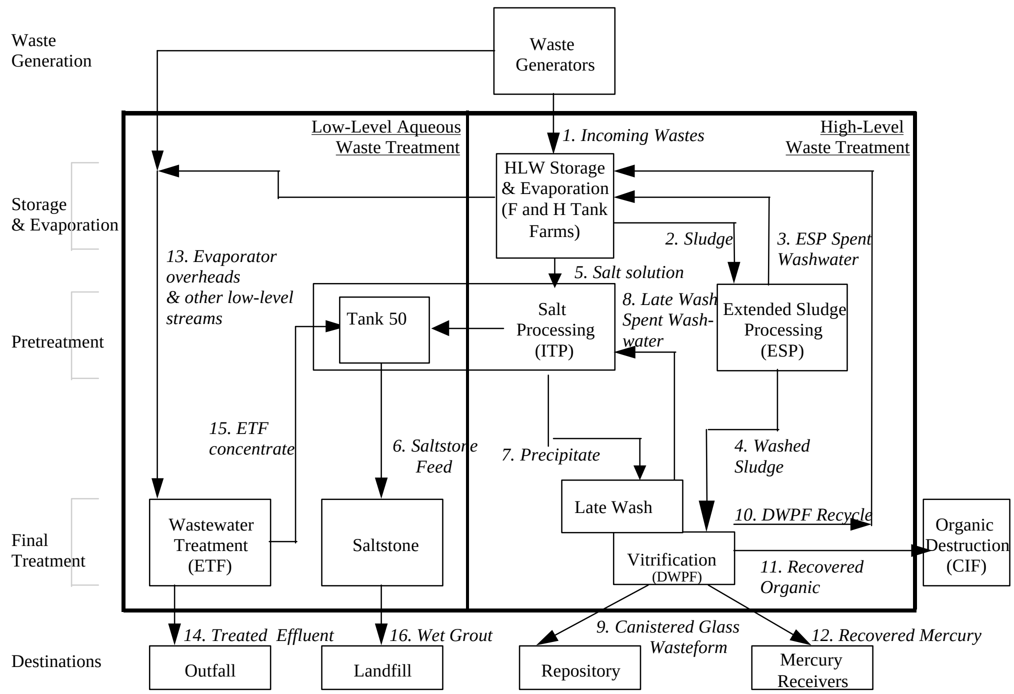

Figure 2-1: HLW System Major Interfaces

2.3 Team Activities

Table 2-1 identifies the activities chartered for the Decision Phase. The activities of items 1 through 5 were designated as primary importance to make a technology selection in FY99. Effort on item 6 was to be pursued only as FY99 funding permitted.

Table 2-1: Decision Phase Actions

ITEM NO.	DESCRIPTION
1	Initiate actions necessary to support the NEPA (Supplemental EIS) process (e.g., evaluate effects on Saltstone Performance Assessment (PA) from the variations in the feeds from the three alternatives and provide support as needed to resolve issued identified).
2	Expand Tank Farm water/salt management studies and develop a strategy and plan to maximize existing tank space flexibility to accommodate any of the alternatives.
3	Perform parallel research and development (R&D) activities to address the technical uncertainties associated with the Crystaline Silicotitanate (CST) Ion Exchange and Small Tank Tetraphenylborate (TPB) Precipitation alternatives.
4	Evaluate the use of existing Tank Farm facilities for the removal of uranium, plutonium, neptunion and strontium from the HLW salt solutions.
5	Provide support to DOE-SR as needed for the Direct Disposal in Grout alternative, including any necessary R&D activities.
6	Initiate further design development only for issues that are common to all alternatives.

The Draft EIS, DOE-EIS-0082-S2D (Reference 1) was subcontracted by DOE to an outside vendor. WSRC has completed the requested tasks in support of the vendor and the Draft EIS is currently scheduled for release in the fourth quarter of calendar year 1999.

WSRC has completed a Systems Engineering evaluation of the tank farm water/salt management approach. The recommended space management strategy and implementation approach are documented in the “High Level Waste Tank Space Management Team Final Report” (Reference 2).

Applied science and technology integration work scope matrix (Reference 8) was developed for CST Non-Elutable Ion Exchange, Small Tank TPB Precipitation, and Direct Disposal in Grout alternatives to identify the key Research and Development (R&D) items to address technical uncertainties identified in the 1998 Selection Process. The scoped R&D Experiment List (Table 2-2) was completed (Reference 14) and the detailed results and technology application information used in the Decision Phase process. Under DOE-HQ Efficient Separations Program cross-cut initiative, Oak Ridge and Argonne National Laboratories conducted research and development on Caustic Side Solvent Extraction alternative aimed at addressing technical uncertainties identified in the 1998 Selection Process. This information was also considered during the Decision Phase process.

Table 2-2: CST Ion Exchange Experiment List

Category	Laboratory Tests	Summary Information
DNFSB 96-1 "Understanding" Issues	a) Effect of pressure and trace organics on cesium removal	No effects on resin performance relative to pressure Pressure and organic resin Kd effects do not appear to affect column performance Trace organics confirmed to coat the resin and reduce Kd by 50%, but does not effect column performance
Safety	a) Column gas generation tests	Gas generation rates equal to calculated amounts Salt solution turned milky white during static resin test (4 days) Large scale column tests exhibited sound performance relative to column hydraulics and gas removal
Glass Impact	a) CST thermal stability	Temperature profile for cesium loading testing showed Kd reduction of 90% from 30°C to 120°C. The Texas A&M CST model Kd prediction was higher for all temperatures vs. actual. Particle analysis showed binder loss and leaching of silicon from CST resin.
	b) DWPF feed homogeneity from CSTIX product	CST settling rate six times faster than glass frit As received CST plugged hydraguard sample Size reduced CST could be sampled, but the sample was not representative
	c) DWPF CST glasses	CST glasses are acceptable for production in DWPF, but will require new property correlation's to be developed.
Operational Performance	a) Effect of column velocity and organics on cesium removal	Two side by side column tests One of the two columns plugged Simulant post precipitation and resin decoloration observed
	b) Thermal and hydraulic properties	Physical properties determined No post precip until –3°C which conflicts with understanding
	c) Scale column operations	Tall column resin loading and conditioning completed successfully Tall column hydraulic profile determined and consistent with expectations
Confirmation of Expectations	a) Column tests with Rad Waste	Saltstone feed specifications met during entire run. Expected column differential pressure and temperature profiles. Column plugged during pH adjustment and blockage removed with backflush

Table 2-3: Small Tank TPB Precipitation Experiment List

Category	Laboratory Tests	Summary Information
Reactor Sizing – Alpha Removal	a) Simulant tests b) Real waste tests	MST absorption kinetics supports alpha removal concurrently with Cesium removal Consistent results with simulant test
Reactor Sizing and Experimental Conditions for Bench Scale – Cs Removal	a) Na/K coprecipitation and solubility b) Cs precipitation and NaTPB dissolution in CSTR (0.5L)	10% NaTPB lost to coprecipitation 60% excess NaTPB supported Short circuit test completed (< 0.1%) 96 hr. (10 turn-overs) tests run with stable flow/hydraulics and no major foaming
Filtration Studies	a) Produce material for DWPF studies b) Confirm filtration parameters	Washed precipitate produced Filter Flux Rates as expected
Bench Scale CSTR Studies (20 L)	a) Series CSTR test(s) – open loop b) Series CSTR test – closed loop with catalyst and precipitate washing	Short circuit test completed (< 0.1 %). 80 hr. (10 turn-overs) tests (Phase I) run with stable flow/ hydraulics and a DF >40,000. TPB washing efficiency significantly lower than predicted. No catalyst activation and no TPB decomposition were observed. 5 concentration cycles and 4 wash cycles completed. Nitrite predictions and targets achieved during washing. 230 hr. close coupled test (Phase 2) run with balanced flow/hydraulics. DF between 25,000 and 60,000 obtained.
DWPF Impacts	a) Precipitate hydrolysis operation b) Glass variability study	Process operated as expected within SPC current performance basis. Higher Cu, Ti, and PHA loading is acceptable
Confirm Expectations	a) Real waste test (0.5 L) with catalyst elements	Foaming problems experienced in CSTRs during Real Waste Test around the 76 hr. run time point Retest exhibited some foaming and performed in a consistent manner with demonstration scale system (DF > 100,000).

Table 2-4: Direct Disposal in Grout Experiment List

Category	Laboratory Tests	Summary Information
Operational Performance	a) MTS/Sludge resuspension	No resuspension problems after 4 and 14 day settling period. High agitator speeds required to resuspend after 60 days. Significant viscosity and sheer stress physical property changes after 60 days at 80°C.
	b) Flocculent/Filter aid	No viable and beneficial filter aide identified relative to improving filter unit flux rates significantly
Waste Form Impacts	c) Grout performance assessment	Previous performance assessment results confirmed

A focused technical and economic evaluation of the current design and plausible alternatives for the removal of uranium, plutonium, neptunium, and strontium from the HLW salt solutions was conducted in accordance with “Position Paper on the Approach to Evaluate Using Existing Facilities for Feed Clarification” (Reference 3). Based on the technical limitations of filtering the resultant material, no viable alternative to the existing approach for feed clarification was identified. The results are documented in “Alternative for Feed Clarification Study” (Reference 4).

The WSRC Management Team, working with key stakeholders in South Carolina and Washington, D.C., has assisted DOE-SR with the advancement of the Direct Disposal in Grout alternative understanding. Additional R&D was also conducted in the area of grout performance.

Up front planning and design input development has been conducted on those elements common to the technology alternatives in accordance with “Position Paper on Prioritization of Common Systems Applicable to the Recommended and Backup Salt Disposition Technologies” (Reference 11). A Systems Engineering (SE) approach was used for selection of a site location and supporting geotechnical work was conducted. The results are documented in “Site Selection for the Salt Disposition Facility at the Savannah River Site” (Reference 5). Other engineering documents (e.g., Facility Design Description, System Design Description, Statements of Work), have been developed and are under engineering change control.

A Life Cycle Cost (LCC) delta cost analysis was performed to assess the impact of the Consolidated Incineration Facility (CIF) on the four short list alternatives to address an Independent Project Evaluation Team comment. The “Life Cycle Cost Re-Examination (CIF Impacts) Report” (Reference 6) concluded that CIF impact was marginal, and does not provide any cost discrimination between the four alternatives. The disposal cost for organic wastes from Caustic Side Solvent Extraction and Small Tank TPB Precipitation, not considering CIF operation, was determined to be negligible relative to the LCC.

A focused economic evaluation regarding moving the precipitate hydrolysis process to the Small Tank TPB Precipitation Facility was conducted since the "High Level Waste Tank Space Management Team Final Report" (Reference 2) recommended a strategy which included placing an evaporator in the DWPF salt processing cell. Based on the study and further technical evaluation, it was concluded that the precipitate hydrolysis process should be included in the new facility. This approach supports the Tank Farm Salt/Space Management strategy, provides for benzene management in a single-purpose built facility and increases the facility throughput equal to the other alternatives. The net result was that an approximately $80M additional capital investment would result in over $950M life cycle cost savings.

Submittal of this report completes the FY99 actions assigned to the HLW Salt Disposition Team for the Decision Phase.

3.0 Decision Process

The Decision Phase was structured as a continuation of the HLW Salt Disposition Systems Engineering Team efforts of 1998 (Figure 3-1). The Decision Phase was developed based on the decision logic (Figure 3-2), to address those attributes highlighted as issues in the WSRC Final Report, WSRC-RP-98-0170, DOE-SR Review Team Final Report, letter to James M. Owendoff dated December 16, 1998, and the Independent Project Evaluation Team Review and Assessment Report, DOE/ID-10672. The four short list alternatives were subjected to the Decision Process (Figure 3-3). Science and technology activities were performed to advance understanding for those technical uncertainties which could potentially provide technical discrimination between the alternatives.

3.1 Process Description of the Four Short List Alternatives

The conceptual process for each alternative is briefly described below. Key streams for each alternative are described to allow similarities and differences among the alternatives to be compared.

Existing infrastructure in the Tank Farms limits the salt solution removal rate to an average of 6,000,000 gallons per year at a sodium concentration of 6.44M. This removal rate along with the approximately 80 million gallons of salt solution to be processed serves as the basis for flowsheets and material balances developed for each alternative. Processing rates for each alternative vary up to this maximum based on interface requirements.

For the four alternatives, salt solution is treated with a slurry of solid MST to sorb soluble strontium and alpha-emitting TRU contaminants (U, Pu, Np, Am, Cm). Small Tank TPB Precipitation combines this treatment with simultaneous cesium precipitation. The other three alternatives require separate MST treatment followed by filtration as an initial process step.

Three of the alternatives – Small Tank TPB Precipitation, Caustic-Side Solvent Extraction and CST Non-Elutable Ion Exchange – reduce the cesium concentration to a level that allows continued use of the existing Saltstone Production Facility and vaults located in Z Area at the Savannah River Site, and continued disposal of salt waste as saltstone in an industrial solid waste landfill. The grout composition for the four alternatives is based on formulations that are comparable to those now used in the current Saltstone Facility.

In the Direct Disposal in Grout alternative, cesium is not removed from the salt solution. Limited shielding in the existing Saltstone Production Facility prevents its use for this alternative. Changes in transfer lines, vaults and permits are also needed to dispose of the saltstone grout. Because of the higher projected cesium concentration, saltstone generated from the Direct Disposal in Grout alternative is within radionuclide concentration limits for Class C low level waste, as defined by the NRC.

3.1.1 Caustic Side Solvent Extraction

In the proposed Caustic-Side Solvent Extraction alternative, salt solution (6.44 M sodium) is combined with dilution water in the Alpha Sorption Tank (AST) within the new shielded facility. Soluble alpha contaminants and strontium are sorbed on monosodium titanate (MST) solids that are added as a slurry to the salt solution in the AST. The solution is diluted to ~6.1 M sodium in the AST in the combined waste stream.

After confirming that soluble alpha concentration has been reduced to an acceptably low level, the resulting slurry is filtered to remove MST and entrained sludge solids. Clarified filtrate is transferred to the Salt Solution Feed Tank and stored until it can be processed.

After sufficient salt solution has been processed in the AST to yield ~5 wt% insoluble solids by filtration, MST and sludge solids that have accumulated in the AST are transferred to a Sludge Solids Receipt Tank within the facility, washed to reduce the soluble salt concentration in the accumulated slurry and then stored until the slurry can be transferred to the DWPF and incorporated into HLW glass.

Caustic-Side Solvent Extraction uses a sparingly soluble (in aqueous solution) organic solvent (Isopar L®) containing an organic-soluble extractant (BobCalixC6; also known as calixerene) and aromatic alcohol modifier that complexes cesium nitrate to remove it from clarified salt solution. The Isopar L® solvent contains 0.01 M calixarene and 0.2 M aromatic alcohol modifier and is fed from the Solvent Hold Tank to the Extraction Stages. This organic solution is contacted with a blend of clarified alkaline aqueous waste fed from the Salt Solution Feed Tank and the aqueous phase from the Acid Scrub Stages.

Cesium nitrate (and some potassium nitrate and sodium nitrate) is extracted from the waste into the organic phase, using a series of countercurrent centrifugal contactors (the Extraction Stages). The cations are stabilized in the solvent phase by the calixarene molecule while the nitrate ion is stabilized by the modifier. Due to the size of the opening in the calixarene molecule, cesium is complexed preferentially to sodium and potassium. This selectivity for cesium is more than two orders of magnitude higher than for potassium and more than four orders of magnitude higher than sodium. This higher selectivity for cesium is required to separate cesium effectively from sodium and potassium in the bulk salt solution. The efficiency of cesium separation is further enhanced by contacting the organic phase from the extraction stages with 0.05 M nitric acid using two centrifugal contactors to remove potassium and sodium salts from the solvent stream (the scrub stages).

The organic phase effluent from the scrub stages is next contacted with a very dilute (0.0005M) nitric acid stream to transfer the cesium to the acidic aqueous stream (the Strip Stages). The aqueous effluent from the strip stages, which is a slightly acidic solution of radioactive cesium nitrate, is sent to an extractant recovery process.

Aqueous decontaminated salt solution (DSS) from the Extraction Stages will contain a small amount of either soluble or entrained organics. Two additional contactors are used to remove soluble organics and recover calixarene and modifier from the aqueous Raffinate exiting the Extraction Stages (Raffinate Organic Removal Stages). A small amount of Isopar L® is introduced into these stages to facilitate the extraction of the modifier and calixarene from the aqueous phase. The organic phase from these two stages is mixed with recycled organic phase and returned to the Extraction Stages. The DSS from the Raffinate Organic Removal Stages is sent to the Aqueous Raffinate Stilling Tank where any residual entrained organics float to the surface and are decanted. From the Aqueous Raffinate Stilling Tank, DSS is transferred to one of two barium Decay Tanks. These two tanks are sized to allow sufficient hold time for secular equilibrium to be re-established between residual cesium and its decay daughter, barium, before the salt solution is analyzed to determine if it has been adequately decontaminated. After analysis confirms adequate decontamination, the DSS is transferred to one of two DSS Hold Tanks and stored until it can be transferred to Z Area for processing and disposal as saltstone.

A similar extractant recovery process is also used for the aqueous strip effluent (acidic solution of extracted cesium nitrate). Two additional contactors are used to remove soluble and entrained organics (Strip Organic Removal Stages). As with the extractant recovery from DSS, a small amount of Isopar L® is introduced into these two stages to extract residual modifier and calixarene from the aqueous strip effluent. The organic stream from this operation is returned to the Strip Stages. The aqueous phase is transferred to the Strip Effluent Stilling Tank where any entrained solvent is removed by decanting. The decanted aqueous solution is then sent to the DWPF Salt Feed Tank and stored until it can be transferred to the DWPF for processing into HLW waste glass.

3.1.2 CST Non-Elutable Ion Exchange

In the proposed CST Non-Elutable Ion Exchange process, salt solution (6.44 M sodium) is combined with dilution water and spent solutions from filter cleaning in the Alpha Sorption Tank (AST) within the new shielded facility. Soluble alpha contaminants and ^{90}Sr are sorbed on monosodium titanate (MST) solids that are added as a slurry to the salt solution in the AST. The solution is diluted to ~5.6 M sodium in the AST in the combined waste stream that is fed to filtration.

After confirming that soluble alpha concentration has been reduced to an acceptably low level, the resulting slurry is filtered to remove MST and entrained sludge solids that may have accompanied the salt solution to the AST. Clarified filtrate is transferred to the Recycle Blend Tank, where it is combined with other aqueous streams generated from resin loading, pretreatment and unloading operations to prepare the columns for operation. Combining these streams yield ~5.3 M sodium solution. The combined stream is stored until it can be processed through the ion exchange column train loaded with CST.

The ion exchange train consists of three operating columns in series, identified as lead, middle and guard columns, where the cesium is exchanged onto the CST. A fourth standby column is provided to allow continued operation while cesium -loaded CST is being removed and fresh CST is being added to the previous lead column. The effluent from the guard column is passed through a fines filter to prevent cesium -loaded fines from contaminating the salt solution. The filtered salt solution flows to one of two Product Holdup Tanks and the activity is measured to ensure it meets the saltstone limit for cesium. These two tanks are sized to allow sufficient hold time for secular equilibrium to be re-established between residual cesium and its decay daughter, barium, before the salt solution is analyzed to determine if it has been adequately decontaminated. After analysis confirms adequate decontamination, the DSS is transferred to one of two DSS Hold Tanks and stored until it can be transferred to Z Area for processing and disposal as saltstone.

When the lead column in the train is close to saturation (expected to be > 90%), that column is removed from service, the second column becomes the lead column, the third column becomes the middle column, and the fresh, standby column becomes the third, or guard, column. The cesium -loaded CST from the first column is then sluiced with water into one of two Loaded Resin Hold Tanks where it is combined with the fines from the fines filter. Excess sluicing water is removed to produce a 10 wt% CST slurry in water. The excess water is sent to the Recycle Blend Tank. The CST slurry is stored in the Loaded Resin Hold Tank until it can be transferred to the DWPF for incorporation into HLW waste glass.

Before being loaded into a column, the CST resin must undergo two treatments. First, the CST is loaded into the Column Preparation Tank, similar in dimensions to an ion exchange column bed. The CST is then backflushed with water to remove the fines. These fines are removed by a filter for disposal as industrial waste. The second treatment involves a 24-hour caustic soak. The as-received CST is partially in the hydrogen form and partially in the sodium form. The resin is converted to the sodium form by circulating a sodium hydroxide solution through the Column Preparation Tank for 24 hours. The material is then loaded into an empty standby column by sluicing with water.

After loading the column, sufficient water must be retained in the column to cover the resin bed and exclude air which might cause channeling in the bed. Prior to placing the loaded standby column in service, the water must be displaced by a 2 M sodium hydroxide solution. If this is not done, aluminum may precipitate from the initial salt solution feed as the pH is reduced by mixing with the residual water. A similar sodium hydroxide flush is required after the a bed is removed from service and before the CST loaded with cesium is sluiced from the bed with water. As noted above, these flushes are sent to the Recycle Blend Tank and combined with clarified salt solution.

3.1.3 Direct Disposal in Grout

At the projected range of concentrations of cesium in salt solution, grout from this process must be produced within a new shielded cell facility, using equipment modified to enable remote operation and maintenance. This facility would be located in Z Area, near the existing industrial waste landfill now containing vaults used for the disposal of saltstone. Shielded transfer lines and remotely operated valve boxes to direct the grout to different vault cells must be provided. Active ventilation with high-efficiency particulate air filtration (HEPA filtration), rather than the passive ventilation now used, is also needed for the disposal vaults because of the higher cesium concentrations expected.

The salt solution must still be treated to reduce the concentration of soluble TRU contaminants and remove any entrained sludge solids that may be present in the salt solution. This treatment assures the grout is at least within alpha limits for NRC Class C low level waste disposal requirements (100 n curie/g), although the Class A limit for alpha activity (10 n curie/g) is preferred for this alternative to facilitate permit modifications for disposal of waste containing higher cesium concentrations. The vault design presently used in the Saltstone Facility meets current regulations for NRC Class C waste disposal. However, the current disposal permit issued by the state of South Carolina presently restricts the average curie content of saltstone placed in a disposal unit (vault cell) to be well within NRC Class A limits.

In the proposed Direct Disposal in Grout alternative, the salt solution (6.44 M sodium) is transferred to the Alpha Sorption Tank (AST) within the new shielded facility used to produce grout. The solution is first diluted to ~6.0 M sodium using process water and spent wash water from filter cleaning and washing of insoluble solids within the facility. Soluble alpha contaminants and strontium are then sorbed on MST solids that are added as a slurry to the salt solution to reduce their soluble concentrations to levels within NRC Class A limits.

After confirming soluble strontium and alpha concentrations have been reduced to an acceptably low level, the resulting slurry is filtered to remove the MST and any entrained sludge solids in the feed solution. The filtrate is then transferred to a Salt Solution Hold Tank and stored until it can be processed within the facility to produce grout for disposal in a saltstone vault. To assure the product is acceptable for disposal, the clarified salt solution must be diluted to a maximum ~6.0 M sodium concentration or to a cesium concentration that yields a final solid waste product that contains less than 4600 curies of cesium per cubic meter, the regulatory limit for cesium in Class C low-level waste. Based on the projected feed solution cesium concentrations, cesium concentrations in saltstone from this alternative would average ~240 curies per cubic meter with a range of concentrations of ~65 to ~700 curies per cubic meter., well within the Class C limit.

After concentrating to ~5 wt% insoluble solids during filtration, MST and sludge solids that collect in the AST are transferred to a Sludge Solids Receipt Tank, washed to reduce the soluble salt concentration in the accumulated slurry and then stored until the slurry can be transferred to the DWPF and incorporated into glass.

3.1.4 Small Tank TPB Precipitation

In the Small Tank TPB Precipitation process, salt solution is received into a Fresh Waste Day Tank located in the new facility. For this continuous precipitation process, salt solution, a solution of sodium tetraphenylborate, a slurry of MST, spent wash water and dilution water are continuously added to a continuous stirred tank reactor (CSTR) located in the new facility. Sufficient dilution water is added to the first CSTR to reduce the sodium molarity to ~4.7 M to optimize conditions for precipitation and MST sorption reactions. The first CSTR feeds a second CSTR to provide the necessary hold up time to complete the reactions. In the CSTRs, soluble cesium and potassium are precipitated as TPB salts and Sr, U, Pu, Am, Np and Cm are sorbed on the MST solids. The resulting slurry, containing ~1 wt% insoluble solids, is transferred from the second CSTR to the Concentrate Tank from which the slurry is continuously fed to a cross-flow filter to concentrate the solids, which contain most of the radioactive contaminants. Decontaminated salt solution filtrate is transferred to a Filtrate Hold Tank from the filter unit and stored until it can be transferred to the existing Saltstone Production Facility located in Z Area where it is converted to saltstone for disposal.

After concentrating the slurry to 10 wt%, and accumulating 4,000 to 5,000 gallons in the Concentrate Tank, the slurry is transferred to the Wash Tank and washed to remove soluble sodium salts by adding process water and removing spent wash water by filtration. Spent wash water is either recycled to the first CSTR to provide a portion of the needed dilution water or sent to the Filtrate Hold Tank and on to Z Area where it is converted to saltstone for disposal. At the end of the washing operation, 10 wt% slurry is transferred to the Precipitate Storage Tank for staging to be processed through the acid hydrolysis unit operation and eventually vitrification. Recovered by-product benzene from acid hydrolysis is transferred to the Consolidated Incinerator Facility (CIF) and incinerated. The aqueous product from acid hydrolysis is combined with sludge feed to the DWPF and incorporated into HLW waste glass.

In the initial proposal for the Small Tank TPB alternative, washed 10 wt% slurry was to be processed using the existing acid hydrolysis process equipment installed in the DWPF Salt Cell. However, a tank farm salt/space management strategy recommends using the DWPF Salt Cell for location of an acid evaporator. This coupled with the limiting design capacity of the existing acid hydrolysis processing equipment, led to the acid hydrolysis process being moved to the new facility with appropriately sized equipment to support the desired waste removal rate. Moving the acid hydrolysis operation to the new facility offers the advantage of confining the operations involving benzene generation and handling to a single facility, but the footprint of the proposed facility would increase for this alternative.

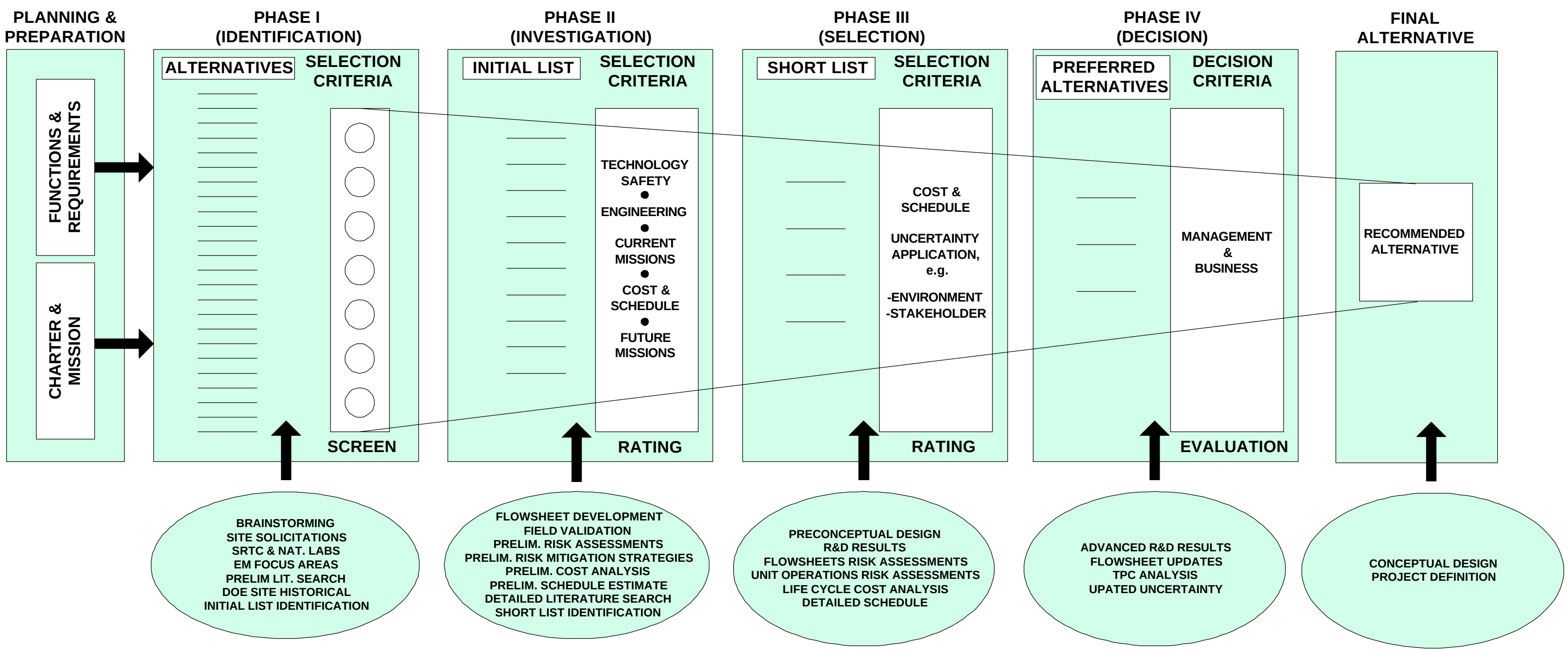

Figure 3-1: Salt Disposition Team Efforts

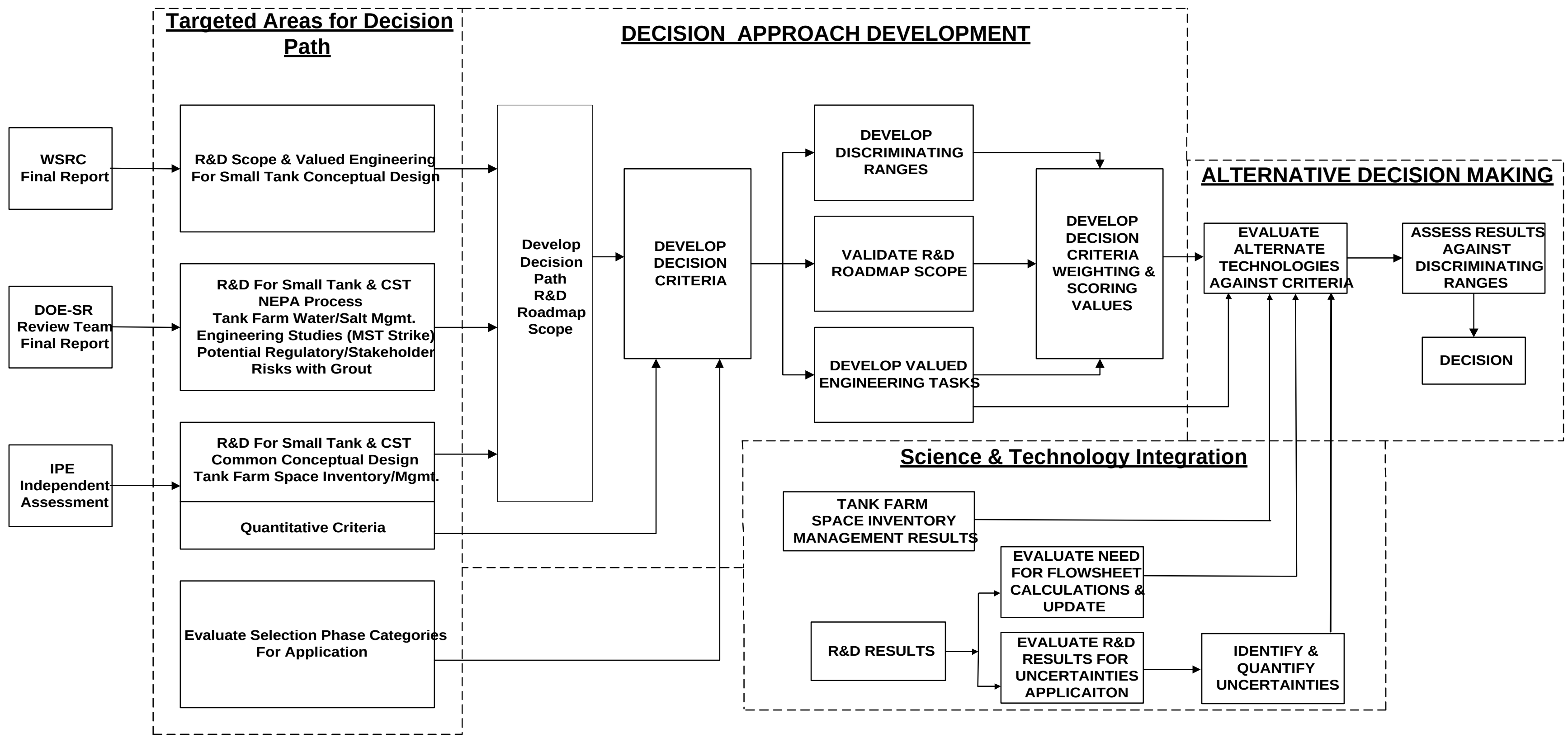

Figure 3-2: Decision Phase Logic Diagram

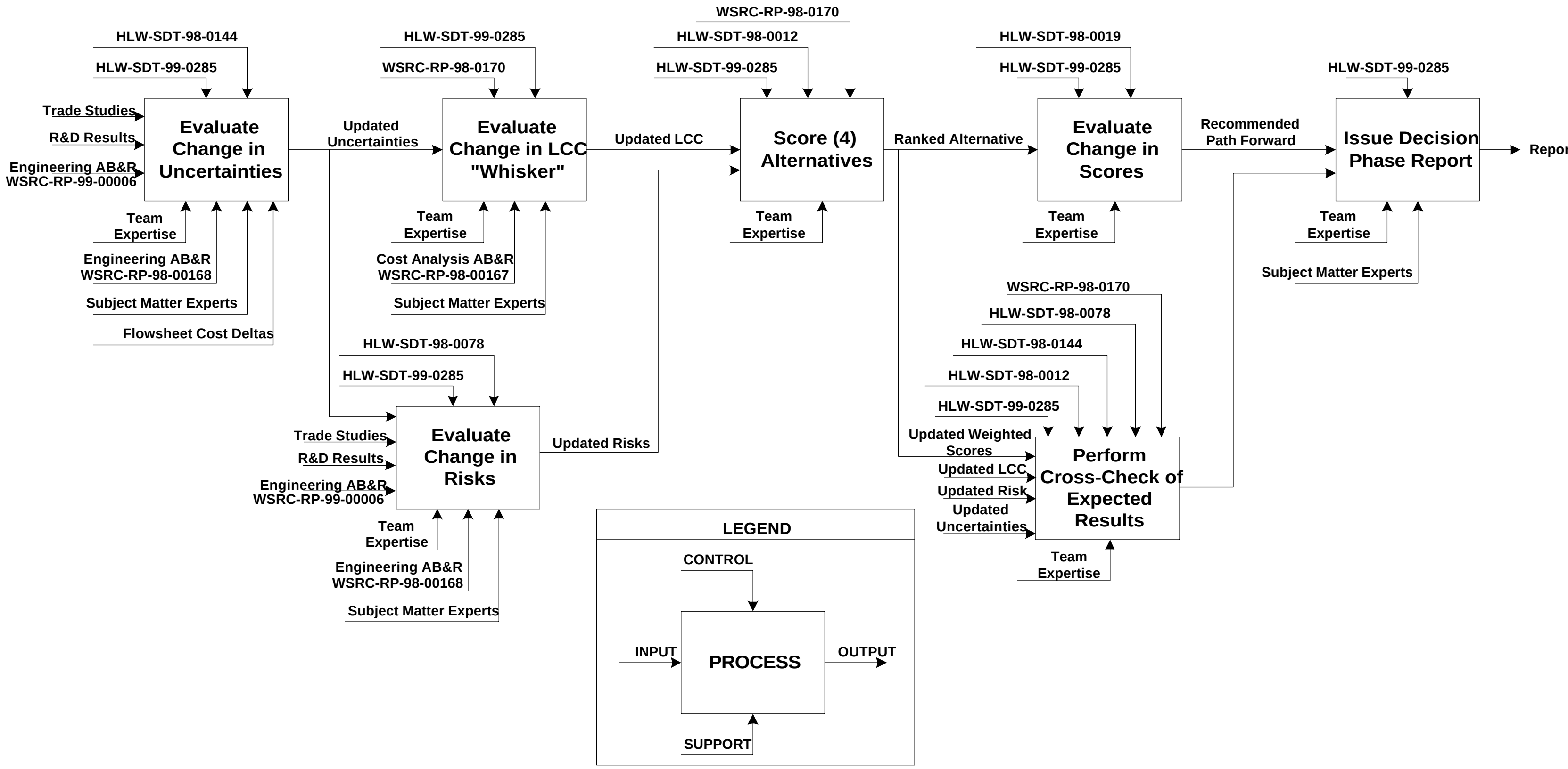

Figure 3-3: Decision Process Business Model

3.2 Uncertainties

The Cost Validation Matrix (Reference 12) is a summary of uncertainties for each alternative evaluated. The process flowsheet, updated R&D results, and application of the R&D results to the process flowsheet were reviewed. Based on the latest information, the Team adjusted the uncertainties, uncertainties impact, or added new uncertainties as appropriate. After each alternative was reviewed, a cross-check was performed to ensure each alternative was addressed consistently. Schedule uncertainties are tabulated in Appendix 7.2 for each alternative. The net impact of the schedule uncertainties, relative to the baseline schedule, are illustrated in Figure 3-4.

3.3 Risks

The Risk Categorization Matrix (Reference 13) is a summary of potential issues for each alternative evaluated. The process flowsheet, updated R&D results, and application of the R&D results to the process flowsheet were reviewed. Based on the latest information, the Team adjusted the risks, risk impact, or added new risks as appropriate. After each alternative was reviewed, a cross-check was performed to ensure each alternative was addressed consistently. If in the process of reviewing the risks, the Team determined an uncertainty was required, then a new uncertainty was added to the Cost Validation Matrix (Appendix 7.3) and addressed accordingly.

3.4 Life Cycle Costs (LCC)

A detailed LCC estimate for each alternative was developed during the 1998 Selection Phase (Reference 7). The Team developed a “Box and Whisker” plot (Figure 3-5) to portray the key information on cost, contingency and uncertainty in a pictorial manner. The “point” contained within the shaded box represents the 1998 LCC Point Estimate, including the 50% probability level contingencies (Reference 7). The “box” represents the upper and lower contingency bounds of the 1998 point estimate. The 1998 dashed “whiskers” represent the net positive or negative uncertainties that are considered to be outside the standard contingency definition.

The assessment of the current understanding resulted in change to both the cost and schedule uncertainties. The solid portion of the “whisker” shows the combined effect.

The Team identified some cost and schedule impacts believed to be confirmed. That is, those uncertainties which shall be realized given today’s understanding. The confirmed cost impacts would result in a change to the “point” estimate. The net confirmed cost impact for Caustic Side Solvent Extraction and Direct Disposal in Grout was negligible. The point and whisker to the right of the shaded box shows the net effect of the confirmed uncertainties for CST Non-Elutable Ion Exchange and Small Tank TPB Precipitation. The results of the evaluation are shown on Figure 3-5.

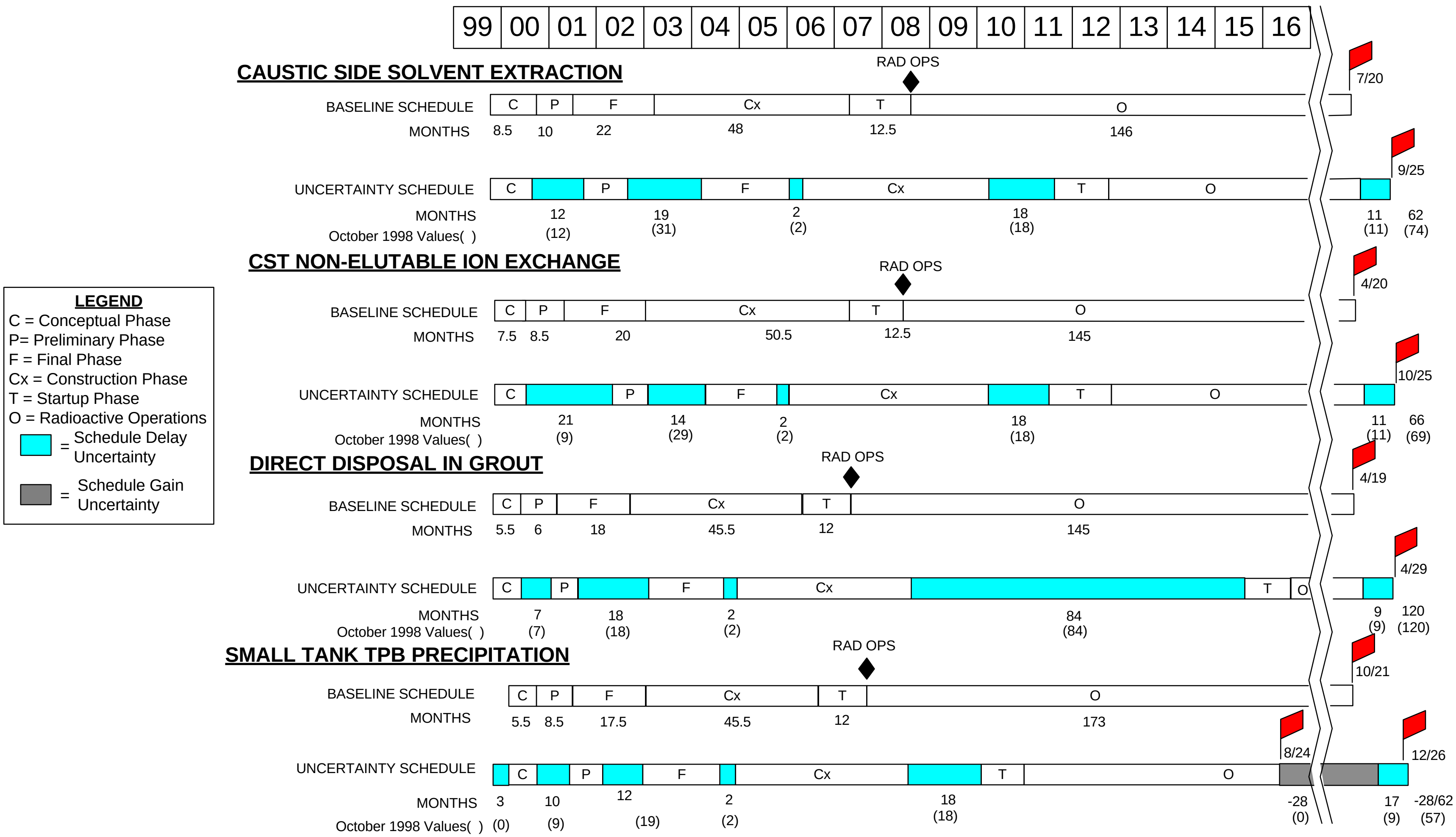

Figure 3-4: Schedule Uncertainties

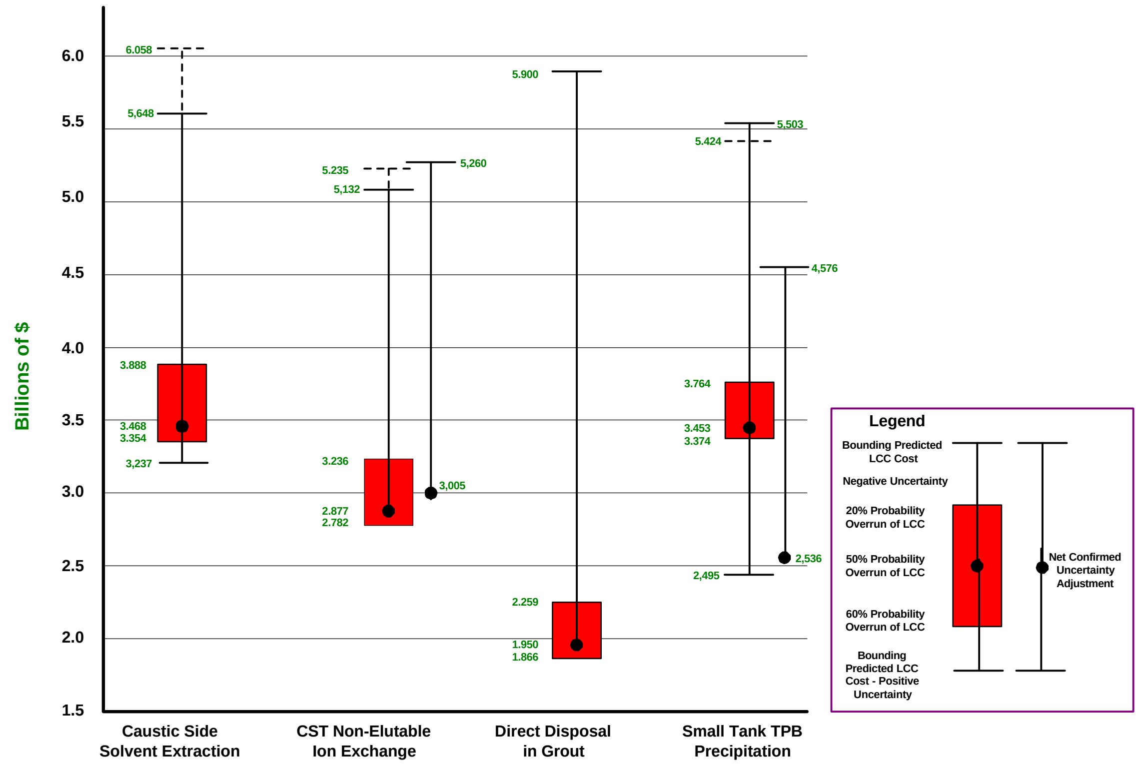

Figure 3-5: Comparative Life Cycle Cost Data

3.5 Technology Ranking

The Team scored each alternative against the same Weighted Evaluation Criteria and Utility Function Values (Reference 10) used for the selection of the four short list alternatives. The alternatives were scored in the areas of technology, current missions, future missions, regulatory, engineering, and cost/schedule factoring in the current knowledge of risks, uncertainties, LCC, and process flowsheet. The results for the technology category are displayed in Table 3-1.

Table 3-1: Technology Scoring

Alternative	Science Maturity	Engineering Maturity	Process Simplicity	Total
Caustic Side Solvent Extraction	4	28	17	49
CST Non-Elutable Ion Exchange	16	28	14	58
Direct Disposal in Grout	38	28	20	86
Small Tank TPB Precipitation	32	32	14	78

- Science Maturity – The level of science understanding needed to minimize project risk.
- Engineering Maturity – The level of applied engineering concepts needed to minimize project risk.
- Process Simplicity – Ease of science implementation understanding by operators.

Direct Disposal in Grout ranked ahead of the other alternatives on the strength of its science maturity and process simplicity. This is attributable to the basic understanding of mixing dry material with liquid salt solution in a proven formula to make saltstone. Small Tank TPB Precipitation ranked next based on its science maturity. The precipitation process is well understood and has been demonstrated with SRS HLW salt solution waste. CST Non-Elutable Ion Exchange ranked ahead of Caustic Side Solvent Extraction based on its science maturity. The CST resin has been demonstrated with real radioactive waste. However, to be suitable for SRS HLW salt solution waste, the resin manufacturing process would require re-engineering. The solvent solution used in Caustic Side Solvent Extraction has only been demonstrated in a laboratory scale, and thus the lowest score and subsequent rank.

The four alternatives scored relatively the same in engineering maturity. This can be attributed to the wide use of the technologies for different applications throughout the world. Thus, the applied engineering concepts are readily available. This area did not provide any significant discrimination.

3.6 Cross-Check

The Team evaluated each alternative to assess the relative change since 1998. The change in the LCC "whisker" was calculated by comparing the 1998 net cost and schedule uncertainty to the 1999 net cost and schedule uncertainty. The weighted score difference was similarly determined. The "effective" risk and "effective" uncertainty was judged by the Team based on the perceived change in being able to successfully deploy the alternative within the baseline project schedule.

The weighted score was the one area where all four alternatives did not reflect the expected result. Additional R&D was expected to provide higher scores as the understanding and resolution of issues is advanced. Because research in the Decision Phase was targeted at specific uncertainties identified in the Selection Phase, the scores were reduced because of the better understanding of the uncertainties, rather than increased.

Due to the limited research performed for Direct Disposal in Grout and Caustic Side Solvent Extraction, their "effective" risk and "effective" uncertainty were unchanged. The investigation of selected issues with CST Non-Elutable Ion Exchange confirmed the negative issues, and thus increased the "effective" risk and "effective" uncertainty because resolution was not assured within the baseline project schedule. Small Tank TPB Precipitation had confirmation of the issues in a positive manner with resolution being achievable, and a potentially improved operating schedule. This resulted in a reduction of the "effective" risk and "effective" uncertainty. The results are shown in Figure 3-6.

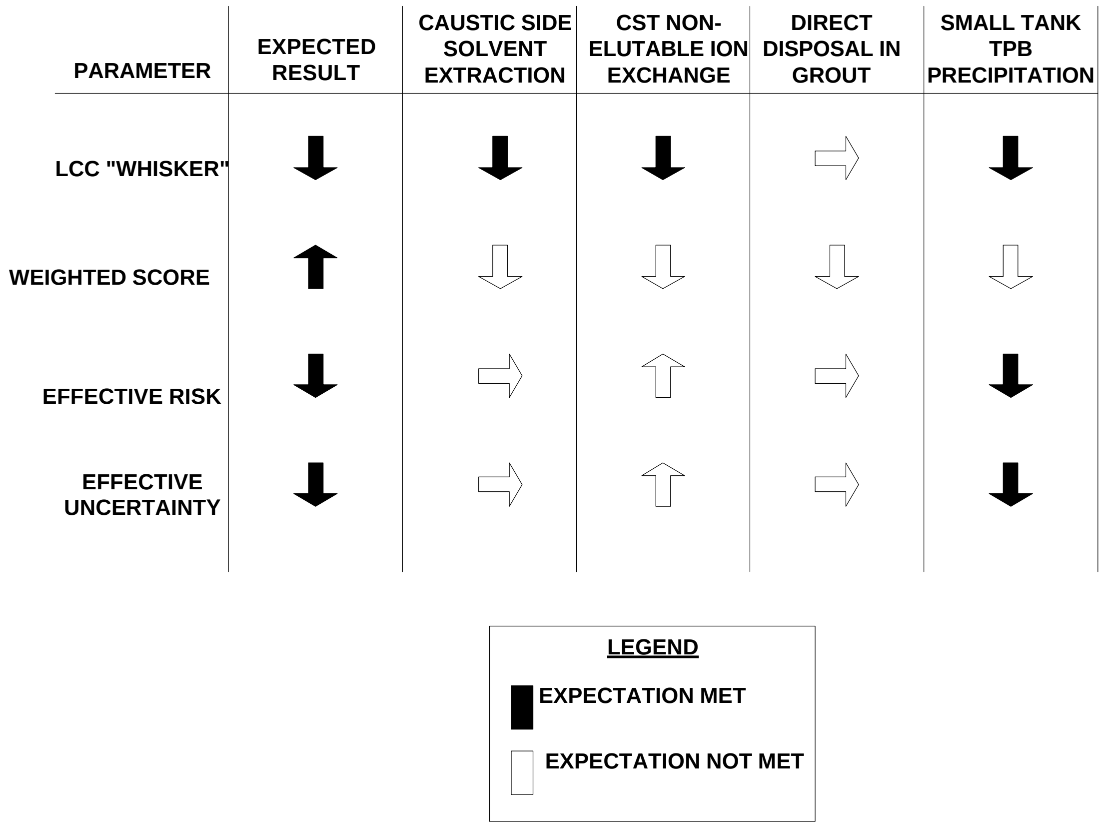

Figure 3-6: Cross-Check Matrix

4.0 Results

The Decision Phase of the Salt Disposition alternative selection process was focused on technical uncertainties identified during the Identification, Investigation, and Selection phases. A detailed science and technology plan was developed and executed to investigate these technical uncertainties. The results of executing the plan and the decision evaluation process have shown that the Small Tank TPB Precipitation alternative is the most suited technical solution relative to current SRS HLW System requirements and needs.

The Decision Phase results also showed that the CST Non-Elutable Ion Exchange alternative is technically sound and identified specific technical items which require further investigation and corrective action. If the remaining open items are addressed, the CST Non-Elutable Ion Exchange alternative can become an effective cesium removal process for the DOE complex.

The Team concluded the most suited technology for processing SRS high level salt solution waste within the defined parameters of Tank Farm Space Management, schedule commitments for decommissioning tanks in the Federal Facilities Agreement and Site Treatment Plan, and interfaces with existing facilities is Small Tank TPB Precipitation. The research conducted has confirmed most of the targeted uncertainties in a positive nature, thus reducing the “effective” risk, and “effective” uncertainties associated with project implementation relative to its position at the end of the 1998 Selection Phase.

4.1 Small Tank Tetraphenylborate (TPB) Precipitation

The team recognized that the most significant issue facing the Small Tank TPB Precipitation process is catalytic decomposition of TPB. Safety concerns resulting from TPB decomposition have been addressed in the pre-conceptual design. The process includes positive pressure nitrogen inerting and secondary confinement of the process vessels. The stainless steel design, with its short processing time, minimizes the product stability issues while achieving the desired cesium decontamination factor. To accomplish product decontamination, the pre-conceptual design material balances have assumed TPB decomposition occurs at the highest rate observed during decomposition studies and has conservatively estimated the facility material inventory (residence time). These material balances indicate the desired DF is maintained at the required production capacity.

The Team also recognized that the catalytic activation process leading to decomposition is not completely understood. This is addressed by continued R&D to better understand these processes and by a feed blending and demonstration strategy for production confirmation. Each 1,000,000 gallon macro-batch of feed to the facility will be processed by bench scale or larger equipment at process conditions expected to maximize decomposition (the loss of DF). Macro-batches, which do not meet the acceptance criteria will be adjusted by re-blending or a change in process conditions. The Team added schedule uncertainity during the operation time period to accommodate any required rework of the blended salt waste.

The Team assessed risks in scientific maturity due to the demonstrated need for an antifoam and the inefficient recovery of TPB during the precipitate washing operation. A schedule uncertainty was also applied to the Preliminary Design to ensure antifoam development is completed. The life cycle cost was increased to purchase additional TPB not recovered by the precipitate washing operation.

Additional risk in engineering maturity was based on the need to further define the method of NaTPB introduction into the precipitation reactor (CSTR #1). Testing to date has demonstrated the importance of NaTPB dispersion to achieve DF.

The Team recognized that the installation of an evaporator in the DWPF Salt Process Cell (SPC), as recommended by the Tank Space Management Team (Reference 2), required the relocation of the precipitate hydrolysis process to this new facility. While this action has an increase in capital cost, it will reduce the operating time by 28 months. This operating time savings is a result of increasing the precipitate hydrolysis process throughput to match the tank farm waste removal limitation and maximizing the DWPF glass production for sludge workoff. Both of these items are corrected to be equivalent to the other alternatives. This is the largest confirmed positive uncertainty for any of the alternatives.

4.2 CST Non-Elutable Ion Exchange

The Team recognized the most significant issue with the CST Ion Exchange is stability of the CST in the highly caustic salt solutions. Testing during the year indicates that, following cesium desorption at temperature, re-adsorption by the resin is reduced to essentially zero when precipitation reactions occur. The developer of the product (Texas A&M University) and the manufacturer of the resin (UOP) have both indicated that this probably occurs from the physical blockage of the resin pores such that cesium cannot diffuse into the resin bead to reach the active resin sites. Precipitation reactions are presumably caused by silica leaching from the resin and subsequent re-precipitation of sodium-aluminum-silicates. The source of the silica is excess material used in the UOP manufacturing process. Both the vendor and developer have indicated that it is possible to eliminate the excess material by re-engineering the manufacturing process, and have further indicated the effort will require from 1 to 2 years, consistent with the original product development. The re-engineered resin must be tested to ensure chemical compatibility and cesium removal efficiency with SRS high level salt solution waste.

Risk associated with scientific maturity was related to the requirement to re-engineer the resin manufacturing process. The risk was previously credited for larger scale radioactive demonstrations (at ORNL), but was adjusted since these were not conducted with highly alkaline waste. Cost and schedule uncertainties were also applied to the Preliminary Design to ensure the re-engineering could be completed.

Additional risk in engineering maturity was based on the need for large surface area filters (3,000 sq. ft.) and large volume recirculation pumps (6,500 to 8,500 gpm) for actinide decontamination due to the low filter flux rate demonstrated during testing. Testing also demonstrated the need to size reduce the particle size of the CST before it can be vitrified in the Defense Waste Processing Facility (DWPF).

The Team identified additional engineered features for management of process temperature, gas disengagement, and explosive gas mixture. The Team also recognized that modifications to the DWPF hydraguard sampling system and re-qualification of the glass product would be required. These items would result in an increase to the project costs and life cycle costs.

4.3 Direct Disposal in Grout

The Team concluded through the evaluation process that the Direct Disposal in Grout should not be considered. The reasoning for arriving at this decision is the non-technical programmatic risks. The recommended alternative must have a sure path to operation by 2010 and the closure of the SRS HLW Tanks in accordance with the FFA and STP commitments. The Team knows of no mitigation strategy that would assure that the facility could be commissioned, NRC, SCDHEC, and EPA approvals could be obtained, and likely court cases resolved in a manner compatible with this schedule. Although acceptably passing the performance assessment requirements, the Team felt that public acceptance would be more difficult than originally anticipated based on recent interaction with the Citizens Advisory Board. The three sequential risks of regulatory approval, political approval, and judicial approval, all of which have been seen in similar instances, could not be guaranteed to be resolved on the necessary schedule with any mitigation strategy the Team could devise.

4.4 Caustic Side Solvent Extraction

It should also be noted that the Team recognized favorable attributes with Caustic Side Solvent Extraction. The limited recent research had positive results, but was not sufficient to change the “effective” risk and “effective” uncertainty regarding project implementation as was concluded in the 1998 Final Report (Reference 7). The relative immaturity of the solvent system was the major deciding factor. Positive attributes associated with this technology were operational, mission and operating schedule flexibility. However, Team judgement was that solvent extraction would require approximately two years of scientific development.

5.0 Recommended Path Forward

WSRC recommends that the Small Tank TPB Precipitation be pursued as the most suited technology for SRS high level salt solution waste processing. Investigation should continue into the understanding of catalyst activation and foaming to disposition these key risks. WSRC also recommends that more detailed evaluations and studies for reuse of existing facilities and alternative unit operation technology be performed. R&D should also continue on the CST Non-Elutable Ion Exchange alternative to address cesium desorption, resin stability, material transport and sampling, and MST filtration risks.

A second option considers the broader DOE complex perspective. This approach would proceed with an aggressive R&D program solely for the CST Non-Elutable Ion Exchange alternative. The R&D would focus on cesium desorption, resin stability, and resin re-engineering risks, with additional effort to pursue material transport and sampling, MST resuspension and filtration, facility interface issues, and glass qualification. Limited R&D efforts to further reduce targeted risk for the Small Tank TPB Precipitation process would continue.

WSRC management estimates a potential total project cost savings of $400M to $700M from the utilization of existing infrastructure at Late Wash, Waste Pretreatment, and Saltstone, and application of alternative unit operation technology. WSRC recommends detailed evaluations and studies be performed to further develop the cost saving concepts.

6.0 Acronyms & Abbreviations

Am	Americium
AST	Alpha Sorption Tank
CIF	Consolidated Incineration Facility
Cm	Curium
Cs	Cesium
CST	Crystalline Silicotitanate
CSTR	Continuous Stirred Tank Reactor
DF	Decontamination Factor
DOE	Department of Energy
DOE-SR	DOE - Savannah River
DSS	Decontaminated Salt Solution
DWPF	Defense Waste Processing Facility
EPA	Environmental Protection Agency
ESP	Extended Sludge Processing
ETF	Effluent Treatment Facility
FFA	Federal Facilities Agreement
HLW	High Level Waste
ISMS	Integrated Safety Management System
ITP	In Tank Precipitation
LCC	Life Cycle Cost
MST	Monosodium Titanate
Np	Neptunium
NRC	Nuclear Regulatory Commission
ORNL	Oak Ridge National Laboratory
Pu	Plutonium
R&D	Research and Development
SCDHEC	South Carolina Department of Health and Environmental Compliance
Sr	Strontium
SRS	Savannah River Site
SRTC	Savannah River Technology Center
STP	Site Treatment Plan
TPB	Tetraphenylborate
TRU	Transuranic
U	Uranium
WSRC	Westinghouse Savannah River Company

7.0 References

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4. HLW-SDT-99-0289, "Alternative for Feed Clarification Study".
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7. WSRC-RP-98-00170, "HLW Salt Disposition System Engineering Team Final Report".
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8.0 Appendices

8.1 Weighted Evaluation Criteria and Utility Function Value Forms

HLW Salt Disposition Systems Engineering Team
Level 1 Evaluation Criteria Assessment Form

Alternative Number: 14 Alternative Title Caustic Side Solvent Extraction

Date: 9/18/99

A. Evaluation Criterion Title: Technology

Evaluation Criterion Description: Maximize the confidence that underlying scientific principles & engineering implementation will result in adequate attainment.

B. Evaluation Criterion ID #: (Note 1) 1.0

C. Evaluation Criterion Weighted Value: $\mathbf{W_1 =}$ **.23**

D. Utility Functions:

Utility Function (UF) Value (V_1) = Σ Level 2 Criterion Weighted Score (WS)

(Note 2)

E. UF Value Formula: (Note 3) $\mathbf{V_1 = WS_{1.1} + WS_{1.2} + WS_{1.3}}$

F. Evaluation Criterion weighted score for the Alternative: $\mathbf{W_1 \times V_1}$ **= Weighted Score** ∴ **.23** × **49.00** = **11.27**

Explanatory Notes for Weighted Score:

Notes:

1. *For Level 1 Evaluation Criterion, the ID# is described by X.0, where X = 1, 2, 3,etc. For Level 2 Evaluation Criterion, the ID# is described by X.1, X.2, X.3, etc. where 'X' is the Level 1 Evaluation Criterion ID#.*
2. *Utility Function values range from 0 (least desirable) to 100 (most desirable).*
3. *If Level 2 Criterion are used, the sum of the Level 2 "Weighted Scores" must be multiplied by the Level 1 Weight to determine the Level 1 Weighted Score.*

HLW Salt Disposition Systems Engineering Team
Level 2 Evaluation Criteria Assessment Form

Alternative Number: 14 Alternative Title Caustic Side Solvent Extraction

Date: 9/18/99

A. Evaluation Criterion Title: Scientific Maturity

Evaluation Criterion Description: The level of scientific understanding needed to minimize project risk.

B. Evaluation Criterion ID #: (Note 1) 1.1

C. Evaluation Criterion Weighted Value: $\mathbf{W_2}$ = **.4**

D. Utility Functions:

	Utility Function (UF) Description:	UF Value (Note 2)
UF.1	Reliable radioactive production scale demonstration & correlation to predicted scientific results.	100
UF.2	Large scale radioactive test; 'spiked' radiochemistry demonstration.	80
UF.3	Pilot (small) scale radioactive test; full radiochemistry.	40
UF.4	Lab scale test; simulant/real waste.	10
UF.5	Theoretical understanding only; no practical demonstration.	0.0

E. **UF VALUE:** $\mathbf{V_2}$ = **10**

Explanatory Notes for UF Selected: Cesium batch extractant/stripping with real Hanford and SRS waste. Lab scale testing for this solvent. Demo for cesium separation with alkaline solution in two centimeter contractors. (Peterson Summary Phase III)

F. Evaluation Criterion weighted score (WS) for the Alternative: $\mathbf{W_2 \times V_2 = WS}$ $\therefore$ **.4** × **10** = **04.00**

Notes:

1. *For Level 1 Evaluation Criterion, the ID# is described by X.0, where X = 1, 2, 3,etc. For Level 2 Evaluation Criterion, the ID# is described by X.1, X.2, X.3, etc. where 'X' is the Level 1 Evaluation Criterion ID#.*

2. *Utility Function values range from 0 (least desirable) to 100 (most desirable).*

3. *If Level 2 Criterion are used, the sum of the Level 2 "Weighted Scores" must be multiplied by the Level 1 Weight to determine the Level 1 Weighted Score.*

HLW Salt Disposition Systems Engineering Team
Level 2 Evaluation Criteria Assessment Form

Alternative Number: 14 Alternative Title Caustic Side Solvent Extraction

Date: 9/18/99

A. Evaluation Criterion Title: Engineering Maturity

Evaluation Criterion Description: The level of applied engineering concepts needed to minimize project risk.

B. Evaluation Criterion ID #: (Note 1) 1.2

C. Evaluation Criterion Weighted Value: **W_2 = .4**

D. Utility Functions:

	Utility Function (UF) Description:	UF Value (Note 2)
UF.1	Reliable radioactive production scale with significant operating experience.	100
UF.2	Reliable non-radioactive production scale with significant operating experience.	60
UF.3	Limited radioactive production scale.	40
UF.4	Limited non-radioactive production scale	20
UF.5	Demonstration	0

E. **UF VALUE:** **V_2 = 70**

Explanatory Notes for UF Selected: SRS (centrifugal contactors), France (centrifugal contactactors), Sellafield and Russia experience with radioactive operation with solvent extraction. Historically, the preferred method for chemical separation. Alpha removal process provides some engineering challenges in the areas of filtration, mixing, and pumping. WSRC-TR-00342; WSRC-RP-99-006

F. Evaluation Criterion weighted score (WS) for the Alternative: **$W_2 \times V_2 = WS \therefore$ .4 $\times$ 70 = 28.00**

Notes:

1. *For Level 1 Evaluation Criterion, the ID# is described by X.0, where X = 1, 2, 3,etc. For Level 2 Evaluation Criterion, the ID# is described by X.1, X.2, X.3, etc. where 'X' is the Level 1 Evaluation Criterion ID#.*

2. *Utility Function values range from 0 (least desirable) to 100 (most desirable).*

3. *If Level 2 Criterion are used, the sum of the Level 2 "Weighted Scores" must be multiplied by the Level 1 Weight to determine the Level 1 Weighted Score.*

HLW Salt Disposition Systems Engineering Team
Level 2 Evaluation Criteria Assessment Form

Alternative Number: 14 Alternative Title Caustic Side Solvent Extraction

Date: 9/18/99

A. Evaluation Criterion Title: Process Simplicity

Evaluation Criterion Description: Ease of Science implementation understanding by operators.

B. Evaluation Criterion ID #: (Note 1) 1.3

C. Evaluation Criterion Weighted Value: **W_2 = .2**

D. Utility Functions:

	Utility Function (UF) Description:	UF Value (Note 2)
UF.1	Low complexity, straight forward operations.	100
UF.2	Moderate complexity - operator aids and routine engineering support.	70
UF.3	Complex - significant training for operators and continuous, specialized engineering support required.	0.0

E. **UF VALUE:** **V_2 = 85**

Explanatory Notes for UF Selected: Limited unit operations. Successful canyon experience with centrifugal contactor operations.

F. Evaluation Criterion weighted score (WS) for the Alternative: **$W_2 \times V_2 = WS \therefore$ .2 $\times$ 85 = 17.00**

Notes:

1. *For Level 1 Evaluation Criterion, the ID# is described by X.0, where X = 1, 2, 3,etc. For Level 2 Evaluation Criterion, the ID# is described by X.1, X.2, X.3, etc. where 'X' is the Level 1 Evaluation Criterion ID#.*
2. *Utility Function values range from 0 (least desirable) to 100 (most desirable).*
3. *If Level 2 Criterion are used, the sum of the Level 2 "Weighted Scores" must be multiplied by the Level 1 Weight to determine the Level 1 Weighted Score.*

HLW Salt Disposition Systems Engineering Team
Level 1 Evaluation Criteria Assessment Form

Alternative Number: 14 Alternative Title Caustic Side Solvent Extraction

Date: 9/18/999/18/99

A. Evaluation Criterion Title: Current Mission Interfaces

Evaluation Criterion Description: Impact on current SRS missions/programs.

B. Evaluation Criterion ID #: 2.0
(Note 1)

C. Evaluation Criterion Weighted Value: $\mathbf{W_1}$ = **.15**

D. Utility Functions:

Utility Function (UF) Value (V_1) = Σ Level 2 Criterion Weighted Score (WS)

(Note 2)

E. UF Value Formula: $\mathbf{V_1 = WS_{2.1} + WS_{2.2} + WS_{2.3} + WS_{2.4} + WS_{2.5}}$
(Note 3)

F. Evaluation Criterion weighted score for the Alternative: $\mathbf{W_1 \times V_1}$ **= Weighted Score** ∴ **.15** × **66.25** = **9.94**

Explanatory Notes for Weighted Score:

Notes:

1. *For Level 1 Evaluation Criterion, the ID# is described by X.0, where X = 1, 2, 3,etc. For Level 2 Evaluation Criterion, the ID# is described by X.1, X.2, X.3, etc. where 'X' is the Level 1 Evaluation Criterion ID#.*

2. *Utility Function values range from 0 (least desirable) to 100 (most desirable).*

3. *If Level 2 Criterion are used, the sum of the Level 2 "Weighted Scores" must be multiplied by the Level 1 Weight to determine the Level 1 Weighted Score.*

HLW Salt Disposition Systems Engineering Team
Level 2 Evaluation Criteria Assessment Form

Alternative Number: 14 Alternative Title Caustic Side Solvent Extraction

Date: 9/18/99

A. Evaluation Criterion Title: DWPF

Evaluation Criterion Description: Impact on DWPF (Table 1 Functions & Requirements).

B. Evaluation Criterion ID #: (Note 1) 2.1

C. Evaluation Criterion Weighted Value: W_2 = **.25**

D. Utility Functions:

	Utility Function (UF) Description:	UF Value (Note 2)
UF.1	Sludge only to completion	100
UF.2	Sludge plus MST to completion.	85
UF.3	Baseline - current ITP flowsheet.	70
UF.4	Moderate impact - some additional canisters (< 50%). Facility modifications required.	20
UF.5	Significant impact - additional canisters (>50%) glass reformulation/repermitting required. Major facility modifications required.	0

E. **UF VALUE:** V_2 = **85**

Explanatory Notes for UF Selected: No Salt Processing Cell operation. Reduced nitric acid addition by DWPF as trim chemicals. The product stream provides a soft interface with DWPF.

F. Evaluation Criterion weighted score (WS) for the Alternative: $W_2 \times V_2 = WS \therefore$ **.25** × **85** = **21.25**

Notes:

1. *For Level 1 Evaluation Criterion, the ID# is described by X.0, where X = 1, 2, 3,etc. For Level 2 Evaluation Criterion, the ID# is described by X.1, X.2, X.3, etc. where 'X' is the Level 1 Evaluation Criterion ID#.*
2. *Utility Function values range from 0 (least desirable) to 100 (most desirable).*
3. *If Level 2 Criterion are used, the sum of the Level 2 "Weighted Scores" must be multiplied by the Level 1 Weight to determine the Level 1 Weighted Score.*

HLW Salt Disposition Systems Engineering Team
Level 2 Evaluation Criteria Assessment Form

Alternative Number: 14 Alternative Title Caustic Side Solvent Extraction

Date: 9/18/99

A. Evaluation Criterion Title: Saltstone

Evaluation Criterion Description: Impact on Saltstone (Table 1 Functions & Requirements).

B. Evaluation Criterion ID #: (Note 1) 2.2

C. Evaluation Criterion Weighted Value: **W_2 = .15**

D. Utility Functions:

	Utility Function (UF) Description:	UF Value (Note 2)
UF.1	No need for Saltstone Facility.	100
UF.2	Reduced throughput required to Saltstone Facility. No hazards release (Benzene).	80
UF.3	180M gallons saltstone plus Benzene risk (current flowsheet).	70
UF.4	Moderate increase in saltstone (<50%). Minor facility modifications.	40
UF.5	Repermit saltstone to Class C waste. Major facility modifications and increased throughtput (>50%).	0

E. **UF VALUE:** **V_2 = 80**

Explanatory Notes for UF Selected: Reduction in saltstone production by 30 million gallons of saltstone grout. No benzene release. Low solvent solubility (20 ppm in aqueous). WSRC-RP-99-0006 for alpha removal.

F. Evaluation Criterion weighted score (WS) for the Alternative: **$W_2 \times V_2$ = WS ∴ .15 × 80 = 12.00**

Notes:

1. *For Level 1 Evaluation Criterion, the ID# is described by X.0, where X = 1, 2, 3,etc. For Level 2 Evaluation Criterion, the ID# is described by X.1, X.2, X.3, etc. where 'X' is the Level 1 Evaluation Criterion ID#.*
2. *Utility Function values range from 0 (least desirable) to 100 (most desirable).*
3. *If Level 2 Criterion are used, the sum of the Level 2 "Weighted Scores" must be multiplied by the Level 1 Weight to determine the Level 1 Weighted Score.*

HLW Salt Disposition Systems Engineering Team
Level 2 Evaluation Criteria Assessment Form

Alternative Number: 14 Alternative Title Caustic Side Solvent Extraction

Date: 9/18/99

A. Evaluation Criterion Title: Solid Waste

Evaluation Criterion Description: Impact on Solid Waste (Table 1 Functions & Requirements).

B. Evaluation Criterion ID #: (Note 1) 2.3

C. Evaluation Criterion Weighted Value: **W_2 = .1**

D. Utility Functions:

	Utility Function (UF) Description:	UF Value (Note 2)
UF.1	Reduced solid waste volume and no Benzene.	100
UF.2	Reduced solid waste volume and Benzene.	80
UF.3	Current flowsheet (Benzene to CIF).	50
UF.4	Moderate increase in solid waste volume.	30
UF.5	Repermit new waste forms, significant increase in solid waste volume.	0

E. **UF VALUE:** **V_2 = 80**

Explanatory Notes for UF Selected: Reduction in liquid benzene generation by 35,000 gallons per year (no benzene generated).

F. Evaluation Criterion weighted score (WS) for the Alternative: **$W_2 \times V_2 = WS \therefore .1 \times 80 = 8.00$**

Notes:

1. *For Level 1 Evaluation Criterion, the ID# is described by X.0, where X = 1, 2, 3,etc. For Level 2 Evaluation Criterion, the ID# is described by X.1, X.2, X.3, etc. where 'X' is the Level 1 Evaluation Criterion ID#.*

2. *Utility Function values range from 0 (least desirable) to 100 (most desirable).*

3. *If Level 2 Criterion are used, the sum of the Level 2 "Weighted Scores" must be multiplied by the Level 1 Weight to determine the Level 1 Weighted Score.*

HLW Salt Disposition Systems Engineering Team
Level 2 Evaluation Criteria Assessment Form

Alternative Number: 14 Alternative Title Caustic Side Solvent Extraction

Date: 9/18/99

A. Evaluation Criterion Title: Tank Farm

Evaluation Criterion Description: Impact on Tank Farm (Table 1 Functions & Requirements).

B. Evaluation Criterion ID #: (Note 1) 2.4

C. Evaluation Criterion Weighted Value: W_2 = **.2**

D. Utility Functions:

	Utility Function (UF) Description:	UF Value (Note 2)
UF.1	Reduced safety hazards, improved operability of tank farm (no blending). Reduced corrosion control impact.	100
UF.2	Current flowsheet.	50
UF.3	Increased safety hazards (e.g. Organics) increase operational capacity, increased corrosion impacts.	0

E. **UF VALUE:** V_2 = **50**

Explanatory Notes for UF Selected: Solvent extraction concentration factor is designed to be the same as the current flowsheet. WSRCC-RP-98-0168, R1.

F. Evaluation Criterion weighted score (WS) for the Alternative: $W_2 \times V_2 = WS \therefore$ **.2** $\times$ **50** = **10.00**

Notes:

1. *For Level 1 Evaluation Criterion, the ID# is described by X.0, where X = 1, 2, 3,etc. For Level 2 Evaluation Criterion, the ID# is described by X.1, X.2, X.3, etc. where 'X' is the Level 1 Evaluation Criterion ID#.*
2. *Utility Function values range from 0 (least desirable) to 100 (most desirable).*
3. *If Level 2 Criterion are used, the sum of the Level 2 "Weighted Scores" must be multiplied by the Level 1 Weight to determine the Level 1 Weighted Score.*

HLW Salt Disposition Systems Engineering Team
Level 2 Evaluation Criteria Assessment Form

Alternative Number: 14 Alternative Title Caustic Side Solvent Extraction

Date: 9/18/99

A. Evaluation Criterion Title: Tank Farm Space Management

Evaluation Criterion Description: Utilization of available Tank Farm storage & resources as a function of time (HLW Salt Disposition Interface Functional Performance Requirement).

B. Evaluation Criterion ID #: 2.5
(Note 1)

C. Evaluation Criterion Weighted Value: $\mathbf{W_2}$ = **.3**

D. Utility Functions:

	Utility Function (UF) Description:	UF Value (Note 2)
UF.1	Accelerate tank space gain. Tank space adequate for current and future missions.	100
UF.2	Current flowsheet (reduces available tank space)	40
UF.3	Accelerated reduction in available tank space (water logged tank farm).	0

E. **UF VALUE:** $\mathbf{V_2}$ = **50**

Explanatory Notes for UF Selected: TK49 readily available for waste storage. TK48 available after waste handling strategy is completed. WSRC-RP-98-00168, R1; WSRC-RP-99-0005.

F. Evaluation Criterion weighted score (WS) for the Alternative: $\mathbf{W_2 \times V_2 = WS \therefore .3 \times 50 = 15.00}$

Notes:

1. *For Level 1 Evaluation Criterion, the ID# is described by X.0, where X = 1, 2, 3,etc. For Level 2 Evaluation Criterion, the ID# is described by X.1, X.2, X.3, etc. where 'X' is the Level 1 Evaluation Criterion ID#.*

2. *Utility Function values range from 0 (least desirable) to 100 (most desirable).*

3. *If Level 2 Criterion are used, the sum of the Level 2 "Weighted Scores" must be multiplied by the Level 1 Weight to determine the Level 1 Weighted Score.*

HLW Salt Disposition Systems Engineering Team
Level 1 Evaluation Criteria Assessment Form

Alternative Number: 14 Alternative Title Caustic Side Solvent Extraction

Date: 9/18/99

A. Evaluation Criterion Title: Future Mission Interfaces

Evaluation Criterion Description: Maximize the support of identified potential future missions.

B. Evaluation Criterion ID #: (Note 1) 3.0

C. Evaluation Criterion Weighted Value: W_1 = **.07**

D. Utility Functions:

	Utility Function (UF) Description:	UF Value (Note 2)
UF.1	Flexible system capable of supporting identified potential future missions.	100
UF.2	System will support can-in-can and spent fuel stabilization.	70
UF.3	System will not support can-in-can or spent fuel stabilization.	0

E. **UF VALUE:** V_1 = **90**

Explanatory Notes for UF Selected: Cesium loading supports can-in-can mission and dispositions the canisters in a Federal Repository. Tank space gain supports spent fuel stabilization mission. Flexibility to expand throughout and vary feed composition. WSRC-TR-98-00370.

F. Evaluation Criterion weighted score (WS) for the Alternative: $W_1 \times V_1 = WS \therefore$ **.07** × **90** = **6.30**

Notes:

1. *For Level 1 Evaluation Criterion, the ID# is described by X.0, where X = 1, 2, 3,etc. For Level 2 Evaluation Criterion, the ID# is described by X.1, X.2, X.3, etc. where 'X' is the Level 1 Evaluation Criterion ID#.*

2. *Utility Function values range from 0 (least desirable) to 100 (most desirable).*

3. *If Level 2 Criterion are used, the sum of the Level 2 "Weighted Scores" must be multiplied by the Level 1 Weight to determine the Level 1 Weighted Score.*

HLW Salt Disposition Systems Engineering Team
Level 1 Evaluation Criteria Assessment Form

Alternative Number: 14 Alternative Title Caustic Side Solvent Extraction

Date: 9/18/99

A. Evaluation Criterion Title: Regulatory/ISMS/Environmental

Evaluation Criterion Description: Protect personnel & the environment from hazards & releases of waste & pollution by ensuring maximum application of intrinsic safety features.

B. Evaluation Criterion ID #: 4.0
(Note 1)

C. Evaluation Criterion Weighted Value: $\mathbf{W_1}$ = **.23**

D. Utility Functions:

Utility Function (UF) Value (V_1) = Σ Level 2 Criterion Weighted Score (WS)

(Note 2)

E. UF Value Formula: $\mathbf{V_1 = WS_{4.1} + WS_{4.2} + WS_{4.3}}$
(Note 3)

F. Evaluation Criterion weighted score for the Alternative: $\mathbf{W_1 \times V_1}$ **= Weighted Score** ∴ **.23** × **64.00** = **14.72**

Explanatory Notes for Weighted Score:

Notes:

1. *For Level 1 Evaluation Criterion, the ID# is described by X.0, where X = 1, 2, 3,etc. For Level 2 Evaluation Criterion, the ID# is described by X.1, X.2, X.3, etc. where 'X' is the Level 1 Evaluation Criterion ID#.*

2. *Utility Function values range from 0 (least desirable) to 100 (most desirable).*

3. *If Level 2 Criterion are used, the sum of the Level 2 "Weighted Scores" must be multiplied by the Level 1 Weight to determine the Level 1 Weighted Score.*

HLW Salt Disposition Systems Engineering Team
Level 2 Evaluation Criteria Assessment Form

Alternative Number: 14   Alternative Title Caustic Side Solvent Extraction

Date: 9/18/99

A. Evaluation Criterion Title: Public/Environment

Evaluation Criterion Description: Protect the public & environment from hazards & accidental releases of waste & pollution by ensuring maximum application of intrinsic safety features.

B. Evaluation Criterion ID #: 4.1
(Note 1)

C. Evaluation Criterion Weighted Value: **W_2 = .45**

D. Utility Functions:

	Utility Function (UF) Description:	UF Value (Note 2)
UF.1	Process is inherently safe and can be quantified/documented in Authorization Basis.	100
UF.2	Process has moderate hazards that are passively mitigated.	85
UF.3	Process has moderate hazards that are readily mitigated.	60
UF.4	Process has inherent hazards that can be mitigated with Engineered Safety Features and Administrative Controls.	35
UF.5	Process has inherent hazards and the risks are not quantifiable.	0

E. **UF VALUE:** **V_2 = 55**

Explanatory Notes for UF Selected: Flammable material in relatively small volumes with a high flash point. Minimal vapor space, predominately liquid filled operations. Hydrogen source in alpha removal tank provides energy for source term dispersion. S-CLC-G-00187.

F. Evaluation Criterion weighted score (WS) for the Alternative: **$W_2 \times V_2 = WS \therefore$ .45 $\times$ 55 = 24.75**

Notes:

1. *For Level 1 Evaluation Criterion, the ID# is described by X.0, where X = 1, 2, 3,etc. For Level 2 Evaluation Criterion, the ID# is described by X.1, X.2, X.3, etc. where 'X' is the Level 1 Evaluation Criterion ID#.*

2. *Utility Function values range from 0 (least desirable) to 100 (most desirable).*

3. *If Level 2 Criterion are used, the sum of the Level 2 "Weighted Scores" must be multiplied by the Level 1 Weight to determine the Level 1 Weighted Score.*

HLW Salt Disposition Systems Engineering Team
Level 2 Evaluation Criteria Assessment Form

Alternative Number: 14 Alternative Title Caustic Side Solvent Extraction

Date: 9/18/99

A. Evaluation Criterion Title: Worker

Evaluation Criterion Description: Protect on-site personnel from hazards & accidental releases of waste & pollution by ensuring maximum application of intrinsic safety features.

B. Evaluation Criterion ID #: (Note 1) 4.2

C. Evaluation Criterion Weighted Value: $\mathbf{W_2}$ = **.35**

D. Utility Functions:

	Utility Function (UF) Description:	UF Value (Note 2)
UF.1	Process is inherently safe and poses no unusual worker safety hazard.	100
UF.2	Process has moderate hazards that are passively mitigated.	80
UF.3	Process has moderate hazards that are readily mitigated.	60
UF.4	Process has inherent hazards that can be mitigated with Structures, Systems, Components and Administrative Controls.	40
UF.5	Process has inherent hazards and poses significant risk to worker safety that are not readily mitigated.	0

E. **UF VALUE:** $\mathbf{V_2}$ = **55**

Explanatory Notes for UF Selected: Flammable material in relatively small volumes. Eliminates benzene emissions. Minimal vapor space, predominantly liquid filled operations. Hydrogen source in alpha removal tank provides energy for source term dispersion. S-CLC-G-00187.

F. Evaluation Criterion weighted score (WS) for the Alternative: $\mathbf{W_2 \times V_2 = WS \therefore}$ **.35** × **55** = **19.25**

Notes:

1. *For Level 1 Evaluation Criterion, the ID# is described by X.0, where X = 1, 2, 3,etc. For Level 2 Evaluation Criterion, the ID# is described by X.1, X.2, X.3, etc. where 'X' is the Level 1 Evaluation Criterion ID#.*

2. *Utility Function values range from 0 (least desirable) to 100 (most desirable).*

3. *If Level 2 Criterion are used, the sum of the Level 2 "Weighted Scores" must be multiplied by the Level 1 Weight to determine the Level 1 Weighted Score.*

HLW Salt Disposition Systems Engineering Team
Level 2 Evaluation Criteria Assessment Form

Alternative Number: 14 Alternative Title Caustic Side Solvent Extraction

Date: 9/18/99

A. Evaluation Criterion Title: Permitting

Evaluation Criterion Description: Minimize waste generation risk & difficulty of permitting new releases & waste forms.

B. Evaluation Criterion ID #: 4.3
(Note 1)

C. Evaluation Criterion Weighted Value: **W_2 = .2**

D. Utility Functions:

	Utility Function (UF) Description:	UF Value (Note 2)
UF.1	No new waste forms requiring permitting, eliminate one or more existing releases, no requalification of existing waste forms.	100
UF.2	Reduction in current releases, no additional permitting required.	80
UF.3	Current flowsheet (Saltstone Facility needs repermitting due to Benzene releases).	60
UF.4	Requalification of existing waste form, exceeds current release levels.	20
UF.5	New waste form permit required, significant increase in environmental releases requiring repermitting, high level waste retained in South Carolina	0

E. **UF VALUE:** **V_2 = 100**

Explanatory Notes for UF Selected: Eliminates benzene releases. No new waste forms.

F. Evaluation Criterion weighted score (WS) for the Alternative: **$W_2 \times V_2$ = WS ∴ .2 × 100 = 20.00**

Notes:

1. *For Level 1 Evaluation Criterion, the ID# is described by X.0, where X = 1, 2, 3,etc. For Level 2 Evaluation Criterion, the ID# is described by X.1, X.2, X.3, etc. where 'X' is the Level 1 Evaluation Criterion ID#.*

2. *Utility Function values range from 0 (least desirable) to 100 (most desirable).*

3. *If Level 2 Criterion are used, the sum of the Level 2 "Weighted Scores" must be multiplied by the Level 1 Weight to determine the Level 1 Weighted Score.*

HLW Salt Disposition Systems Engineering Team
Level 1 Evaluation Criteria Assessment Form

Alternative Number: 14 Alternative Title Caustic Side Solvent Extraction

Date: 9/18/99

A. Evaluation Criterion Title: Engineering (Design)

Evaluation Criterion Description: Maximize the confidence that the facility meets applicable codes, standards & required production throughput.

B. Evaluation Criterion ID #: 5.0
(Note 1)

C. Evaluation Criterion Weighted Value: $\mathbf{W_1} =$ **.2**

D. Utility Functions:

Utility Function (UF) Value (V_1) = Σ Level 2 Criterion Weighted Score (WS)

(Note 2)

E. UF Value Formula: $\mathbf{V_1 = WS_{5.1} + WS_{5.2} + WS_{5.3} + WS_{5.4}}$
(Note 3)

F. Evaluation Criterion weighted score for the Alternative: $\mathbf{W_1 \times V_1}$ **= Weighted Score** ∴ **.2** × **77.50** = **15.50**

Explanatory Notes for Weighted Score:

Notes:

1. *For Level 1 Evaluation Criterion, the ID# is described by X.0, where X = 1, 2, 3,etc. For Level 2 Evaluation Criterion, the ID# is described by X.1, X.2, X.3, etc. where 'X' is the Level 1 Evaluation Criterion ID#.*

2. *Utility Function values range from 0 (least desirable) to 100 (most desirable).*

3. *If Level 2 Criterion are used, the sum of the Level 2 "Weighted Scores" must be multiplied by the Level 1 Weight to determine the Level 1 Weighted Score.*

HLW Salt Disposition Systems Engineering Team
Level 2 Evaluation Criteria Assessment Form

Alternative Number: 14 Alternative Title Caustic Side Solvent Extraction

Date: 9/18/99

A. Evaluation Criterion Title: Construct

Evaluation Criterion Description: Ensure facility design considers major construction/testing methods and needs in accordance with Integrated Work Process (IWP) and Key Activities for Successful Execution (KASE).

B. Evaluation Criterion ID #: (Note 1) 5.1

C. Evaluation Criterion Weighted Value: $\mathbf{W_2}$ = **.25**

D. Utility Functions:

	Utility Function (UF) Description:	UF Value (Note 2)
UF.1	Facility design features and construction methods lead to simplicity of construction/testing process.	100
UF.2	Facility design features allows application of standard construction/testing practices (routine complexity).	60
UF.3	Facility design features and construction methods are difficult to apply due to non-standard, non-commercial methods not readily applied in radioactive environment.	0

E. **UF VALUE:** $\mathbf{V_2}$ = **85**

Explanatory Notes for UF Selected: Existing modular design of contactors incorporating canyon experience lessons learned. Simple unit operations (tanks, evaporator).

F. Evaluation Criterion weighted score (WS) for the Alternative: $\mathbf{W_2 \times V_2 = WS \therefore .25 \times 85 = 21.25}$

Notes:

1. *For Level 1 Evaluation Criterion, the ID# is described by X.0, where X = 1, 2, 3,etc. For Level 2 Evaluation Criterion, the ID# is described by X.1, X.2, X.3, etc. where 'X' is the Level 1 Evaluation Criterion ID#.*

2. *Utility Function values range from 0 (least desirable) to 100 (most desirable).*

3. *If Level 2 Criterion are used, the sum of the Level 2 "Weighted Scores" must be multiplied by the Level 1 Weight to determine the Level 1 Weighted Score.*

HLW Salt Disposition Systems Engineering Team
Level 2 Evaluation Criteria Assessment Form

Alternative Number: 14 Alternative Title Caustic Side Solvent Extraction

Date: 9/18/99

A. Evaluation Criterion Title: Qualify

Evaluation Criterion Description: Readily validate defined functional design requirements, regulatory requirements, final disposal forms, and Authorization Basis (AB) safety requirements.

B. Evaluation Criterion ID #: (Note 1) 5.2

C. Evaluation Criterion Weighted Value: $\mathbf{W_2}$ = **.25**

D. Utility Functions:

	Utility Function (UF) Description:	UF Value (Note 2)
UF.1	Test program has known acceptance criteria and accomodates direct verification of design attributes.	100
UF.2	Test program applies "Graded Approach" to verify key design attributes with other limited testing and inferred results.	70
UF.3	Insufficient science/engineering exists to establish firm test acceptance criteria and methods, limited direct verification.	0

E. **UF VALUE:** $\mathbf{V_2}$ = **80**

Explanatory Notes for UF Selected: Majority of design attributes provide for direct verification. Process variables will require some inferred results. Modular unit testing would use some bounding acceptance data.

F. Evaluation Criterion weighted score (WS) for the Alternative: $\mathbf{W_2 \times V_2 = WS}$ ∴ **.25** × **80** = **20.00**

Notes:

1. *For Level 1 Evaluation Criterion, the ID# is described by X.0, where X = 1, 2, 3,etc. For Level 2 Evaluation Criterion, the ID# is described by X.1, X.2, X.3, etc. where 'X' is the Level 1 Evaluation Criterion ID#.*
2. *Utility Function values range from 0 (least desirable) to 100 (most desirable).*
3. *If Level 2 Criterion are used, the sum of the Level 2 "Weighted Scores" must be multiplied by the Level 1 Weight to determine the Level 1 Weighted Score.*

HLW Salt Disposition Systems Engineering Team
Level 2 Evaluation Criteria Assessment Form

Alternative Number: 14 Alternative Title Caustic Side Solvent Extraction

Date: 9/18/99

A. Evaluation Criterion Title: Operate

Evaluation Criterion Description: Maximize ease of repeat operation/proceduralization, access for round sheets/physical verification, and upset operation management (Section R-1.4-3 of Functions & Requirements).

B. Evaluation Criterion ID #: 5.3
(Note 1)

C. Evaluation Criterion Weighted Value: $\mathbf{W_2}$ = **.25**

D. Utility Functions:

	Utility Function (UF) Description:	UF Value (Note 2)
UF.1	Design allows simple, coordinated, straight forward operation with direct access to key controls, interlocks, and instruments. Easy access to key equipment, maximize ALARA considerations. Minimize number of process control points.	100
UF.2	Design allows manageable operation with minimal complexity (Standard SRS practice).	60
UF.3	Design is highly coupled with minimum holdup, multiple parallel operations and fast dynamics, and process instability.	0

E. **UF VALUE:** $\mathbf{V_2}$ = **75**

Explanatory Notes for UF Selected: Comparable to current SRS canyon operation. Limited number of unit operations.

F. Evaluation Criterion weighted score (WS) for the Alternative: $\mathbf{W_2 \times V_2 = WS \ \therefore}$ **.25** × **75** = **18.75**

Notes:

1. *For Level 1 Evaluation Criterion, the ID# is described by X.0, where X = 1, 2, 3,etc. For Level 2 Evaluation Criterion, the ID# is described by X.1, X.2, X.3, etc. where 'X' is the Level 1 Evaluation Criterion ID#.*

2. *Utility Function values range from 0 (least desirable) to 100 (most desirable).*

3. *If Level 2 Criterion are used, the sum of the Level 2 "Weighted Scores" must be multiplied by the Level 1 Weight to determine the Level 1 Weighted Score.*

HLW Salt Disposition Systems Engineering Team
Level 2 Evaluation Criteria Assessment Form

Alternative Number: 14 Alternative Title Caustic Side Solvent Extraction

Date: 9/18/99

A. Evaluation Criterion Title: RAMI

Evaluation Criterion Description: Design to maximize Reliability, Availability, Maintainability, and Inspectability.

B. Evaluation Criterion ID #: (Note 1) 5.4

C. Evaluation Criterion Weighted Value: $\mathbf{W_2}$ = **.25**

D. Utility Functions:

	Utility Function (UF) Description:	UF Value (Note 2)
UF.1	Design allows simple, coordinated, straight forward maintenance practices which take into account ALARA requirements. Design maximizes reliability, and availability of Structures, Systems, and Components.	100
UF.2	Design allows manageable maintenance functions with minimal complexibility (Standard SRS practice).	60
UF.3	Design complexity restricts maintainability and inspectability and reduces reliability, availability of Structures, Systems, and Components. Remoteability restricts maintainability.	0

E. **UF VALUE:** $\mathbf{V_2}$ = **70**

Explanatory Notes for UF Selected: Latest generation of contactor has been improved to incorporate maintenance lessons learned. Alpha removal equipment size adds RAMI complexity. WSRC-RP-99-0006

F. Evaluation Criterion weighted score (WS) for the Alternative: $\mathbf{W_2 \times V_2 = WS} \therefore$ **.25** × **70** = **17.50**

Notes:

1. *For Level 1 Evaluation Criterion, the ID# is described by X.0, where X = 1, 2, 3,etc. For Level 2 Evaluation Criterion, the ID# is described by X.1, X.2, X.3, etc. where 'X' is the Level 1 Evaluation Criterion ID#.*

2. *Utility Function values range from 0 (least desirable) to 100 (most desirable).*

3. *If Level 2 Criterion are used, the sum of the Level 2 "Weighted Scores" must be multiplied by the Level 1 Weight to determine the Level 1 Weighted Score.*

HLW Salt Disposition Systems Engineering Team
Level 1 Evaluation Criteria Assessment Form

Alternative Number: 14 Alternative Title Caustic Side Solvent Extraction

Date: 9/18/99

A. Evaluation Criterion Title: Cost/Schedule

Evaluation Criterion Description: Meet minimum combination of programmatic and technical risks and life cycle costs.

B. Evaluation Criterion ID #: 6.0
(Note 1)

C. Evaluation Criterion Weighted Value: **W_1 = .12**

D. Utility Functions:

Utility Function (UF) Value (V_1) = Σ Level 2 Criterion Weighted Score (WS)

(Note 2)

E. UF Value Formula: **$V_1 = WS_{6.1} + WS_{6.2} + WS_{6.3}$**
(Note 3)

F. Evaluation Criterion weighted score for the Alternative: **$W_1 \times V_1$ = Weighted Score ∴ .12 × 83.00 = 9.96**

Explanatory Notes for Weighted Score: ____________________

Notes:

1. *For Level 1 Evaluation Criterion, the ID# is described by X.0, where X = 1, 2, 3,etc. For Level 2 Evaluation Criterion, the ID# is described by X.1, X.2, X.3, etc. where 'X' is the Level 1 Evaluation Criterion ID#.*

2. *Utility Function values range from 0 (least desirable) to 100 (most desirable).*

3. *If Level 2 Criterion are used, the sum of the Level 2 "Weighted Scores" must be multiplied by the Level 1 Weight to determine the Level 1 Weighted Score.*

HLW Salt Disposition Systems Engineering Team
Level 2 Evaluation Criteria Assessment Form

Alternative Number: 14 Alternative Title Caustic Side Solvent Extraction

Date: 9/18/99

A. Evaluation Criterion Title: Regulatory Schedule Commitments

Evaluation Criterion Description: Maximize capability of disposing of radioactive wastes per Federal Facility Agreement (FFA) & Site Treatment Plan (STP) schedules or earlier.

B. Evaluation Criterion ID #: 6.1
(Note 1)

C. Evaluation Criterion Weighted Value: W_2 = **.5**

D. Utility Functions:

	Utility Function (UF) Description:	UF Value (Note 2)
UF.1	Accelerated Cleanup Plan (ACP) to empty High Level Waste (HLW) tanks by 2022 is met.	100
UF.2	Base Site Treatment Plan (STP) requirement to close HLW tanks by 2028 is met.	70
UF.3	Base STP or Federal Facility Agreement (FFA) requirements to close HLW tanks by committed dates is not met.	0

E. **UF VALUE:** V_2 = **90**

Explanatory Notes for UF Selected: DWPF operation supports STP requirement. Flexibility to expand throughput to potentially meet ACP.

F. Evaluation Criterion weighted score (WS) for the Alternative: $W_2 \times V_2 = WS \therefore$ **.5** × **90** = **45.00**

Notes:

1. *For Level 1 Evaluation Criterion, the ID# is described by X.0, where X = 1, 2, 3,etc. For Level 2 Evaluation Criterion, the ID# is described by X.1, X.2, X.3, etc. where 'X' is the Level 1 Evaluation Criterion ID#.*
2. *Utility Function values range from 0 (least desirable) to 100 (most desirable).*
3. *If Level 2 Criterion are used, the sum of the Level 2 "Weighted Scores" must be multiplied by the Level 1 Weight to determine the Level 1 Weighted Score.*

HLW Salt Disposition Systems Engineering Team
Level 2 Evaluation Criteria Assessment Form

Alternative Number: 14 Alternative Title Caustic Side Solvent Extraction

Date: 9/18/99

A. Evaluation Criterion Title: Life Cycle Costs (LCC)

Evaluation Criterion Description: Minimize LCC including TEC, OPC, and D&D (excludes salvage and repository costs).

B. Evaluation Criterion ID #: (Note 1) 6.2

C. Evaluation Criterion Weighted Value: **W_2 = .3**

D. Utility Functions:

	Utility Function (UF) Description:	UF Value (Note 2)
UF.1	LCC ≤ 2 billion dollars.	100
UF.2	LCC is 4 billion dollars.	50
UF.3	LCC is 8 billion dollars.	25
UF.4	LCC ≥ 16 billion dollars.	0

E. **UF VALUE:** **V_2 = 60**

Explanatory Notes for UF Selected: LCC equals 3.5 billion dollars. Based on the point estimate. WSRC-RP-99-00167.

F. Evaluation Criterion weighted score (WS) for the Alternative: **$W_2 \times V_2$ = WS ∴ .3 × 60 = 18.00**

Notes:

1. *For Level 1 Evaluation Criterion, the ID# is described by X.0, where X = 1, 2, 3,etc. For Level 2 Evaluation Criterion, the ID# is described by X.1, X.2, X.3, etc. where 'X' is the Level 1 Evaluation Criterion ID#.*

2. *Utility Function values range from 0 (least desirable) to 100 (most desirable).*

3. *If Level 2 Criterion are used, the sum of the Level 2 "Weighted Scores" must be multiplied by the Level 1 Weight to determine the Level 1 Weighted Score.*

HLW Salt Disposition Systems Engineering Team
Level 2 Evaluation Criteria Assessment Form

Alternative Number: 14 Alternative Title Caustic Side Solvent Extraction

Date: 9/18/99

A. Evaluation Criterion Title: Repository Costs

Evaluation Criterion Description: Minimize cost for waste disposal off-site (Federal Repository).

B. Evaluation Criterion ID #: (Note 1) 6.3

C. Evaluation Criterion Weighted Value: **W_2 = .2**

D. Utility Functions:

	Utility Function (UF) Description:	UF Value (Note 2)
UF.1	≤ 6000 canisters for off-site disposal	100
UF.2	68,000 canisters for off-site disposal.	50
UF.3	≥ 130,000 canisters for off-site disposal	0

E. **UF VALUE:** **V_2 = 100**

Explanatory Notes for UF Selected: DWPF canister production remains at 6000.

F. Evaluation Criterion weighted score (WS) for the Alternative: **$W_2 \times V_2 = WS \therefore .2 \times 100 = 20.00$**

Notes:

1. *For Level 1 Evaluation Criterion, the ID# is described by X.0, where X = 1, 2, 3,etc. For Level 2 Evaluation Criterion, the ID# is described by X.1, X.2, X.3, etc. where 'X' is the Level 1 Evaluation Criterion ID#.*

2. *Utility Function values range from 0 (least desirable) to 100 (most desirable).*

3. *If Level 2 Criterion are used, the sum of the Level 2 "Weighted Scores" must be multiplied by the Level 1 Weight to determine the Level 1 Weighted Score.*

7.1.2 CST Non-Elutable Ion Exchange

HLW Salt Disposition Systems Engineering Team
Level 1 Evaluation Criteria Assessment Form

Alternative Number: 6 Alternative Title Crystalline Silicotitanate (CST) Ion Exchange - DWPF Vitrification

Date: 9/18/99

A. Evaluation Criterion Title: Technology

Evaluation Criterion Description: Maximize the confidence that underlying scientific principles & engineering implementation will result in adequate attainment.

B. Evaluation Criterion ID #: 1.0
(Note 1)

C. Evaluation Criterion Weighted Value: $\mathbf{W_1}$ = **.23**

D. Utility Functions:

Utility Function (UF) Value (V_1) = Σ Level 2 Criterion Weighted Score (WS)

(Note 2)

E. UF Value Formula: $\mathbf{V_1 = WS_{1.1} + WS_{1.2} + WS_{1.3}}$
(Note 3)

F. Evaluation Criterion weighted score for the Alternative: $\mathbf{W_1 \times V_1}$ **= Weighted Score ∴ .23 × 58.00 = 13.34**

Explanatory Notes for Weighted Score:

Notes:

1. *For Level 1 Evaluation Criterion, the ID# is described by X.0, where X = 1, 2, 3,etc. For Level 2 Evaluation Criterion, the ID# is described by X.1, X.2, X.3, etc. where 'X' is the Level 1 Evaluation Criterion ID#.*

2. *Utility Function values range from 0 (least desirable) to 100 (most desirable).*

3. *If Level 2 Criterion are used, the sum of the Level 2 "Weighted Scores" must be multiplied by the Level 1 Weight to determine the Level 1 Weighted Score.*

HLW Salt Disposition Systems Engineering Team
Level 2 Evaluation Criteria Assessment Form

Alternative Number: 6 Alternative Title: Crystalline Silicotitanate (CST) Ion Exchange - DWPF Vitrification

Date: 9/18/99

A. Evaluation Criterion Title: Scientific Maturity

Evaluation Criterion Description: The level of scientific understanding needed to minimize project risk.

B. Evaluation Criterion ID #: (Note 1) 1.1

C. Evaluation Criterion Weighted Value: $\mathbf{W_2}$ = **.4**

D. Utility Functions:

	Utility Function (UF) Description:	UF Value (Note 2)
UF.1	Reliable radioactive production scale demonstration & correlation to predicted scientific results.	100
UF.2	Large scale radioactive test; 'spiked' radiochemistry demonstration.	80
UF.3	Pilot (small) scale radioactive test; full radiochemistry.	40
UF.4	Lab scale test; simulant/real waste.	10
UF.5	Theoretical understanding only; no practical demonstration.	0.0

E. **UF VALUE:** $\mathbf{V_2}$ = **40**

Explanatory Notes for UF Selected: Oak Ridge large scale radioactive demonstration and numerous lab and pilot scale tests, but not with SRS high alkaline waste. DF and cesium loading has only been demonstrated with SRS waste at lab scale. R&D results indicate performance and throughput issues which require resin re-engineering for SRS waste. DWPF glass production experience requires changes to an existing formulation and requalification. WSRC-RP-99-0006; WSRC-TR-99-00245

F. Evaluation Criterion weighted score (WS) for the Alternative: $\mathbf{W_2 \times V_2 = WS \therefore}$ **.4** × **40** = **16.00**

Notes:

1. *For Level 1 Evaluation Criterion, the ID# is described by X.0, where X = 1, 2, 3,etc. For Level 2 Evaluation Criterion, the ID# is described by X.1, X.2, X.3, etc. where 'X' is the Level 1 Evaluation Criterion ID#.*

2. *Utility Function values range from 0 (least desirable) to 100 (most desirable).*

3. *If Level 2 Criterion are used, the sum of the Level 2 "Weighted Scores" must be multiplied by the Level 1 Weight to determine the Level 1 Weighted Score.*

HLW Salt Disposition Systems Engineering Team
Level 2 Evaluation Criteria Assessment Form

Alternative Number: 6 Alternative Title Crystalline Silicotitanate (CST) Ion Exchange - DWPF Vitrification

Date: 9/18/99

A. Evaluation Criterion Title: Engineering Maturity

Evaluation Criterion Description: The level of applied engineering concepts needed to minimize project risk.

B. Evaluation Criterion ID #: (Note 1) 1.2

C. Evaluation Criterion Weighted Value: **W_2 = .4**

D. Utility Functions:

	Utility Function (UF) Description:	UF Value (Note 2)
UF.1	Reliable radioactive production scale with significant operating experience.	100
UF.2	Reliable non-radioactive production scale with significant operating experience.	60
UF.3	Limited radioactive production scale.	40
UF.4	Limited non-radioactive production scale	20
UF.5	Demonstration	0

E. **UF VALUE:** **V_2 = 70**

Explanatory Notes for UF Selected: Oak Ridge experience in radioactive production. DWPF glass production experience. West Valley radioactive production experience. Loaded resin requires size reduction which leads to resuspension uncertainties in the downstream process. Limited experience in high radiation field work with carousel configuration. Alpha removal process provides some engineering challenges in the areas of filtration, mixing, and pumping. WSRC-RP-99-0006; WSRC-RT-99-00342, June 1, 1998 West Valley Trip Report

F. Evaluation Criterion weighted score (WS) for the Alternative: **$W_2 \times V_2 = WS \therefore$ .4 $\times$ 70 = 28.00**

Notes:

1. *For Level 1 Evaluation Criterion, the ID# is described by X.0, where X = 1, 2, 3,etc. For Level 2 Evaluation Criterion, the ID# is described by X.1, X.2, X.3, etc. where 'X' is the Level 1 Evaluation Criterion ID#.*

2. *Utility Function values range from 0 (least desirable) to 100 (most desirable).*

3. *If Level 2 Criterion are used, the sum of the Level 2 "Weighted Scores" must be multiplied by the Level 1 Weight to determine the Level 1 Weighted Score.*

HLW Salt Disposition Systems Engineering Team
Level 2 Evaluation Criteria Assessment Form

Alternative Number: 6 Alternative Title Crystalline Silicotitanate (CST) Ion Exchange - DWPF Vitrification

Date: 9/18/99

A. Evaluation Criterion Title: Process Simplicity

Evaluation Criterion Description: Ease of science implementation understanding by operators.

B. Evaluation Criterion ID #: (Note 1) 1.3

C. Evaluation Criterion Weighted Value: $\mathbf{W_2}$ = **.2**

D. Utility Functions:

	Utility Function (UF) Description:	UF Value (Note 2)
UF.1	Low complexity, straight forward operations.	100
UF.2	Moderate complexity - operator aids and routine engineering support.	70
UF.3	Complex - significant training for operators and continuous, specialized engineering support required.	0.0

E. **UF VALUE:** $\mathbf{V_2}$ = **70**

Explanatory Notes for UF Selected: Several unit operations which are straight forward with added coupling to DWPF sludge only operations.

F. Evaluation Criterion weighted score (WS) for the Alternative: $\mathbf{W_2 \times V_2 = WS}$ $\therefore$ **.2** × **70** = **14.00**

Notes:

1. *For Level 1 Evaluation Criterion, the ID# is described by X.0, where X = 1, 2, 3,etc. For Level 2 Evaluation Criterion, the ID# is described by X.1, X.2, X.3, etc. where 'X' is the Level 1 Evaluation Criterion ID#.*

2. *Utility Function values range from 0 (least desirable) to 100 (most desirable).*

3. *If Level 2 Criterion are used, the sum of the Level 2 "Weighted Scores" must be multiplied by the Level 1 Weight to determine the Level 1 Weighted Score.*

HLW Salt Disposition Systems Engineering Team
Level 1 Evaluation Criteria Assessment Form

Alternative Number: 6 Alternative Title Crystalline Silicotitanate (CST) Ion Exchange - DWPF Vitrification

Date: 9/18/99

A. Evaluation Criterion Title: Current Mission Interfaces

Evaluation Criterion Description: Impact on current SRS missions/programs.

B. Evaluation Criterion ID #: (Note 1) 2.0

C. Evaluation Criterion Weighted Value: $\mathbf{W_1}$ = **.15**

D. Utility Functions:

Utility Function (UF) Value (V_1) = Σ Level 2 Criterion Weighted Score (WS)

(Note 2)

E. UF Value Formula: (Note 3) $\mathbf{V_1 = WS_{2.1} + WS_{2.2} + WS_{2.3} + WS_{2.4} + WS_{2.5}}$

F. Evaluation Criterion weighted score for the Alternative: $\mathbf{W_1 \times V_1}$ **= Weighted Score** ∴ **.15** × **60.50** = **9.07**

Explanatory Notes for Weighted Score:

Notes:

1. *For Level 1 Evaluation Criterion, the ID# is described by X.0, where X = 1, 2, 3,etc. For Level 2 Evaluation Criterion, the ID# is described by X.1, X.2, X.3, etc. where 'X' is the Level 1 Evaluation Criterion ID#.*

2. *Utility Function values range from 0 (least desirable) to 100 (most desirable).*

3. *If Level 2 Criterion are used, the sum of the Level 2 "Weighted Scores" must be multiplied by the Level 1 Weight to determine the Level 1 Weighted Score.*

HLW Salt Disposition Systems Engineering Team
Level 2 Evaluation Criteria Assessment Form

Alternative Number: 6 Alternative Title Crystalline Silicotitanate (CST) Ion Exchange - DWPF Vitrification

Date: 9/18/99

A. Evaluation Criterion Title: DWPF

Evaluation Criterion Description: Impact on DWPF (Table 1 Functions & Requirements).

C. Evaluation Criterion ID #: (Note 1) 2.1

C. Evaluation Criterion Weighted Value: W_2 = **.25**

E. Utility Functions:

	Utility Function (UF) Description:	UF Value (Note 2)
UF.1	Sludge only to completion	100
UF.2	Sludge plus MST to completion.	85
UF.3	Baseline - current ITP flowsheet.	70
UF.4	Moderate impact - some additional canisters (< 50%). Facility modifications required.	20
UF.5	Significant impact - additional canisters (>50%) glass reformulation/repermitting required. Major facility modifications required.	0

E. **UF VALUE:** V_2 = **40**

Explanatory Notes for UF Selected: CST and MST added to the DWPF sludge only flowsheet. Late Wash Facility and Salt Process Cell operation are not required. Loaded resin requires size reduction which leads to resuspension and sampling efficacy uncertainties in DWPF. Glass requalification is required to address glass viscosity, model refinements and possible reformulation. WSRC-TR-99-00245; WSRC-TR-99-00309; WSRC-TR-99-00302; WSRC-RP-99-0006

F. Evaluation Criterion weighted score (WS) for the Alternative: $W_2 \times V_2 = WS \therefore$ **.25** × **40** = **10.00**

Notes:

1. *For Level 1 Evaluation Criterion, the ID# is described by X.0, where X = 1, 2, 3,etc. For Level 2 Evaluation Criterion, the ID# is described by X.1, X.2, X.3, etc. where 'X' is the Level 1 Evaluation Criterion ID#.*

2. *Utility Function values range from 0 (least desirable) to 100 (most desirable).*

3. *If Level 2 Criterion are used, the sum of the Level 2 "Weighted Scores" must be multiplied by the Level 1 Weight to determine the Level 1 Weighted Score.*

HLW Salt Disposition Systems Engineering Team
Level 2 Evaluation Criteria Assessment Form

Alternative Number: 6 Alternative Title Crystalline Silicotitanate (CST) Ion Exchange - DWPF Vitrification

Date: 9/18/99

A. Evaluation Criterion Title: Saltstone

Evaluation Criterion Description: Impact on Saltstone (Table 1 Functions & Requirements).

B. Evaluation Criterion ID #: (Note 1) 2.2

C. Evaluation Criterion Weighted Value: $\mathbf{W_2}$ = **.15**

D. Utility Functions:

	Utility Function (UF) Description:	UF Value (Note 2)
UF.1	No need for Saltstone Facility.	100
UF.2	Reduced throughput required to Saltstone Facility. No hazards release (Benzene).	80
UF.3	180M gallons saltstone plus Benzene risk (current flowsheet).	70
UF.4	Moderate increase in saltstone (<50%). Minor facility modifications.	40
UF.5	Repermit saltstone to Class C waste. Major facility modifications and increased throughtput (>50%).	0

E. **UF VALUE:** $\mathbf{V_2}$ = **80**

Explanatory Notes for UF Selected: Reduction in saltstone production by 30 million gallons of saltstone grout. No benzene release.

F. Evaluation Criterion weighted score (WS) for the Alternative: $\mathbf{W_2 \times V_2 = WS \therefore .15 \times 80 = 12.00}$

Notes:

1. *For Level 1 Evaluation Criterion, the ID# is described by X.0, where X = 1, 2, 3,etc. For Level 2 Evaluation Criterion, the ID# is described by X.1, X.2, X.3, etc. where 'X' is the Level 1 Evaluation Criterion ID#.*

2. *Utility Function values range from 0 (least desirable) to 100 (most desirable).*

3. *If Level 2 Criterion are used, the sum of the Level 2 "Weighted Scores" must be multiplied by the Level 1 Weight to determine the Level 1 Weighted Score.*

HLW Salt Disposition Systems Engineering Team
Level 2 Evaluation Criteria Assessment Form

Alternative Number: 6 Alternative Title Crystalline Silicotitanate (CST) Ion Exchange - DWPF Vitrification

Date: 9/18/99

A. Evaluation Criterion Title: Solid Waste

Evaluation Criterion Description: Impact on Solid Waste (Table 1 Functions & Requirements).

B. Evaluation Criterion ID #: (Note 1) 2.3

C. Evaluation Criterion Weighted Value: $\mathbf{W_2}$ = **.1**

D. Utility Functions:

	Utility Function (UF) Description:	UF Value (Note 2)
UF.1	Reduced solid waste volume and no Benzene.	100
UF.2	Reduced solid waste volume and Benzene.	80
UF.3	Current flowsheet (Benzene to CIF).	50
UF.4	Moderate increase in solid waste volume.	30
UF.5	Repermit new waste forms, significant increase in solid waste volume.	0

E. **UF VALUE:** $\mathbf{V_2}$ = **80**

Explanatory Notes for UF Selected: Reduction in liquid benzene generation by 35,000 gallons per year (no benzene generated).

F. Evaluation Criterion weighted score (WS) for the Alternative: $\mathbf{W_2 \times V_2 = WS \therefore .1 \times 80 = 8.00}$

Notes:

1. *For Level 1 Evaluation Criterion, the ID# is described by X.0, where X = 1, 2, 3,etc. For Level 2 Evaluation Criterion, the ID# is described by X.1, X.2, X.3, etc. where 'X' is the Level 1 Evaluation Criterion ID#.*
2. *Utility Function values range from 0 (least desirable) to 100 (most desirable).*
3. *If Level 2 Criterion are used, the sum of the Level 2 "Weighted Scores" must be multiplied by the Level 1 Weight to determine the Level 1 Weighted Score.*

HLW Salt Disposition Systems Engineering Team
Level 2 Evaluation Criteria Assessment Form

Alternative Number: 6 Alternative Title Crystalline Silicotitanate (CST) Ion Exchange - DWPF Vitrification

Date: 9/18/99

A. Evaluation Criterion Title: Tank Farm

Evaluation Criterion Description: Impact on Tank Farm (Table 1 Functions & Requirements).

B. Evaluation Criterion ID #: (Note 1) 2.4

C. Evaluation Criterion Weighted Value: $\mathbf{W_2}$ = **.2**

D. Utility Functions:

	Utility Function (UF) Description:	UF Value (Note 2)
UF.1	Reduced safety hazards, improved operability of tank farm (no blending). Reduced corrosion control impact.	100
UF.2	Current flowsheet.	50
UF.3	Increased safety hazards (e.g. Organics) increase operational capacity, increased corrosion impacts.	0

E. **UF VALUE:** $\mathbf{V_2}$ = **70**

Explanatory Notes for UF Selected: Reduced organics transferred to the Tank Farm. Reduced recycle stream relative to the base case ITP.

F. Evaluation Criterion weighted score (WS) for the Alternative: $\mathbf{W_2 \times V_2 = WS \;\therefore\; .2 \times 70 = 14.00}$

Notes:

1. *For Level 1 Evaluation Criterion, the ID# is described by X.0, where X = 1, 2, 3,etc. For Level 2 Evaluation Criterion, the ID# is described by X.1, X.2, X.3, etc. where 'X' is the Level 1 Evaluation Criterion ID#.*
2. *Utility Function values range from 0 (least desirable) to 100 (most desirable).*
3. *If Level 2 Criterion are used, the sum of the Level 2 "Weighted Scores" must be multiplied by the Level 1 Weight to determine the Level 1 Weighted Score.*

HLW Salt Disposition Systems Engineering Team
Level 2 Evaluation Criteria Assessment Form

Alternative Number: 6 Alternative Title Crystalline Silicotitanate (CST) Ion Exchange - DWPF Vitrification

Date: 9/18/99

A. Evaluation Criterion Title: Tank Farm Space Management

Evaluation Criterion Description: Utilization of available Tank Farm storage & resources as a function of time (HLW Salt Disposition Interface Functional Performance Requirement).

B. Evaluation Criterion ID #: (Note 1) 2.5

C. Evaluation Criterion Weighted Value: $\mathbf{W_2}$ = **.3**

D. Utility Functions:

Utility Function (UF) Description:		UF Value (Note 2)
UF.1	Accelerate tank space gain. Tank space adequate for current and future missions.	100
UF.2	Current flowsheet (reduces available tank space)	40
UF.3	Accelerated reduction in available tank space (water logged tank farm).	0

E. **UF VALUE:** $\mathbf{V_2}$ = **55**

Explanatory Notes for UF Selected: TK49 readily available for waste storage. TK48 available after waste handling strategy is completed. Reduced recycle volume. WSRC-RP-99-0005; WSRC-RP-99-0006

F. Evaluation Criterion weighted score (WS) for the Alternative: $\mathbf{W_2 \times V_2 = WS} \therefore$ **.3** × **55** = **16.50**

Notes:

1. *For Level 1 Evaluation Criterion, the ID# is described by X.0, where X = 1, 2, 3,etc. For Level 2 Evaluation Criterion, the ID# is described by X.1, X.2, X.3, etc. where 'X' is the Level 1 Evaluation Criterion ID#.*
2. *Utility Function values range from 0 (least desirable) to 100 (most desirable).*
3. *If Level 2 Criterion are used, the sum of the Level 2 "Weighted Scores" must be multiplied by the Level 1 Weight to determine the Level 1 Weighted Score.*

HLW Salt Disposition Systems Engineering Team
Level 1 Evaluation Criteria Assessment Form

Alternative Number: 6 Alternative Title Crystalline Silicotitanate (CST) Ion Exchange - DWPF Vitrification

Date: 9/18/99

A. Evaluation Criterion Title: Future Mission Interfaces

Evaluation Criterion Description: Maximize the support of identified potential future missions.

B. Evaluation Criterion ID #: (Note 1) 3.0

C. Evaluation Criterion Weighted Value: **W_1 = .07**

D. Utility Functions:

	Utility Function (UF) Description:	UF Value (Note 2)
UF.1	Flexible system capable of supporting identified potential future missions.	100
UF.2	System will support can-in-can and spent fuel stabilization.	70
UF.3	System will not support can-in-can or spent fuel stabilization.	0

E. **UF VALUE:** **V_1 = 70**

Explanatory Notes for UF Selected: Cesium loading supports can-in-can mission and dispositions the canisters in a Federal Repository. Tank space gain supports spent fuel stabilization mission.

F. Evaluation Criterion weighted score (WS) for the Alternative: **$W_1 \times V_1 = WS \therefore .07 \times 70 = 4.90$**

Notes:

1. *For Level 1 Evaluation Criterion, the ID# is described by X.0, where X = 1, 2, 3,etc. For Level 2 Evaluation Criterion, the ID# is described by X.1, X.2, X.3, etc. where 'X' is the Level 1 Evaluation Criterion ID#.*

2. *Utility Function values range from 0 (least desirable) to 100 (most desirable).*

3. *If Level 2 Criterion are used, the sum of the Level 2 "Weighted Scores" must be multiplied by the Level 1 Weight to determine the Level 1 Weighted Score.*

HLW Salt Disposition Systems Engineering Team
Level 1 Evaluation Criteria Assessment Form

Alternative Number: 6 Alternative Title Crystalline Silicotitanate (CST) Ion Exchange - DWPF Vitrification

Date: 9/18/99

A. Evaluation Criterion Title: Regulatory/ISMS/Environmental

Evaluation Criterion Description: Protect personnel & the environment from hazards & releases of waste & pollution by ensuring maximum application of intrinsic safety features.

B. Evaluation Criterion ID #: 4.0
(Note 1)

C. Evaluation Criterion Weighted Value: $\mathbf{W_1}$ = **.23**

D. Utility Functions:

Utility Function (UF) Value (V_1) = Σ Level 2 Criterion Weighted Score (WS)

(Note 2)

E. UF Value Formula: $\mathbf{V_1 = WS_{4.1} + WS_{4.2} + WS_{4.3}}$
(Note 3)

F. Evaluation Criterion weighted score for the Alternative: $\mathbf{W_1 \times V_1}$ **= Weighted Score** ∴ **.23** × **39.75** = **9.14**

Explanatory Notes for Weighted Score:

Notes:

1. *For Level 1 Evaluation Criterion, the ID# is described by X.0, where X = 1, 2, 3,etc. For Level 2 Evaluation Criterion, the ID# is described by X.1, X.2, X.3, etc. where 'X' is the Level 1 Evaluation Criterion ID#.*

2. *Utility Function values range from 0 (least desirable) to 100 (most desirable).*

3. *If Level 2 Criterion are used, the sum of the Level 2 "Weighted Scores" must be multiplied by the Level 1 Weight to determine the Level 1 Weighted Score.*

HLW Salt Disposition Systems Engineering Team
Level 2 Evaluation Criteria Assessment Form

Alternative Number: 6 Alternative Title Crystalline Silicotitanate (CST) Ion Exchange - DWPF Vitrification

Date: 9/18/99

A. Evaluation Criterion Title: Public/Environment

Evaluation Criterion Description: Protect the public & environment from hazards & accidental releases of waste & pollution by ensuring maximum application of intrinsic safety features.

B. Evaluation Criterion ID #: (Note 1) 4.1

C. Evaluation Criterion Weighted Value: $\mathbf{W_2}$ = **.45**

D. Utility Functions:

	Utility Function (UF) Description:	UF Value (Note 2)
UF.1	Process is inherently safe and can be quantified/documented in Authorization Basis.	100
UF.2	Process has moderate hazards that are passively mitigated.	85
UF.3	Process has moderate hazards that are readily mitigated.	60
UF.4	Process has inherent hazards that can be mitigated with Engineered Safety Features and Administrative Controls.	35
UF.5	Process has inherent hazards and the risks are not quantifiable.	0

E. **UF VALUE:** $\mathbf{V_2}$ = **35**

Explanatory Notes for UF Selected: Higher source term cesium loading on resin leads to temperature management concerns and large quantities of hydrogen and oxygen concentrations in detonable levels. WSRC-TR-99-00285; No benzene in the process. Hydrogen source in alpha removal tank provides energy for source term dispersion. WSRC-RP-99-0006

F. Evaluation Criterion weighted score (WS) for the Alternative: $\mathbf{W_2 \times V_2 = WS \therefore}$ **.45** × **35** = **15.75**

Notes:

1. *For Level 1 Evaluation Criterion, the ID# is described by X.0, where X = 1, 2, 3,etc. For Level 2 Evaluation Criterion, the ID# is described by X.1, X.2, X.3, etc. where 'X' is the Level 1 Evaluation Criterion ID#.*

2. *Utility Function values range from 0 (least desirable) to 100 (most desirable).*

3. *If Level 2 Criterion are used, the sum of the Level 2 "Weighted Scores" must be multiplied by the Level 1 Weight to determine the Level 1 Weighted Score.*

HLW Salt Disposition Systems Engineering Team
Level 2 Evaluation Criteria Assessment Form

Alternative Number: 6 Alternative Title Crystalline Silicotitanate (CST) Ion Exchange - DWPF Vitrification

Date: 9/18/99

A. Evaluation Criterion Title: Worker

Evaluation Criterion Description: Protect on-site personnel from hazards & accidental releases of waste & pollution by ensuring maximum application of intrinsic safety features.

B. Evaluation Criterion ID #: (Note 1) 4.2

C. Evaluation Criterion Weighted Value: $\mathbf{W_2}$ = **.35**

D. Utility Functions:

	Utility Function (UF) Description:	UF Value (Note 2)
UF.1	Process is inherently safe and poses no unusual worker safety hazard.	100
UF.2	Process has moderate hazards that are passively mitigated.	80
UF.3	Process has moderate hazards that are readily mitigated.	60
UF.4	Process has inherent hazards that can be mitigated with Structures, Systems, Components and Administrative Controls.	40
UF.5	Process has inherent hazards and poses significant risk to worker safety that are not readily mitigated.	0

E. **UF VALUE:** $\mathbf{V_2}$ = **40**

Explanatory Notes for UF Selected: No benzene hazard. Higher source term cesium loading on resin leads to temperature management concerns and large quantities of hydrogen and oxygen concentrations in detonable levels. Hydrogen source in alpha removal tank provides energy for source term dispersion. WSRC-TR-99-00285; WSRC-RP-99-0006; S-CLC-G-00187

F. Evaluation Criterion weighted score (WS) for the Alternative: $\mathbf{W_2 \times V_2 = WS} \therefore$ **.35** × **40** = **14.00**

Notes:

1. *For Level 1 Evaluation Criterion, the ID# is described by X.0, where X = 1, 2, 3,etc. For Level 2 Evaluation Criterion, the ID# is described by X.1, X.2, X.3, etc. where 'X' is the Level 1 Evaluation Criterion ID#.*

2. *Utility Function values range from 0 (least desirable) to 100 (most desirable).*

3. *If Level 2 Criterion are used, the sum of the Level 2 "Weighted Scores" must be multiplied by the Level 1 Weight to determine the Level 1 Weighted Score.*

HLW Salt Disposition Systems Engineering Team
Level 2 Evaluation Criteria Assessment Form

Alternative Number: 6 Alternative Title Crystalline Silicotitanate (CST) Ion Exchange - DWPF Vitrification

Date: 9/18/99

A. Evaluation Criterion Title: Permitting

Evaluation Criterion Description: Minimize waste generation risk & difficulty of permitting new releases & waste forms.

B. Evaluation Criterion ID #: (Note 1) 4.3

C. Evaluation Criterion Weighted Value: **W_2 = .2**

D. Utility Functions:

	Utility Function (UF) Description:	UF Value (Note 2)
UF.1	No new waste forms requiring permitting, eliminate one or more existing releases, no requalification of existing waste forms.	100
UF.2	Reduction in current releases, no additional permitting required.	80
UF.3	Current flowsheet (Saltstone Facility needs repermitting due to Benzene releases).	60
UF.4	Requalification of existing waste form, exceeds current release levels.	20
UF.5	New waste form permit required, significant increase in environmental releases requiring repermitting, high level waste retained in South Carolina	0

E. **UF VALUE:** **V_2 = 50**

Explanatory Notes for UF Selected: Eliminates benzene releases. Requalification of DWPF glass with new constituents. Reduction in NO_x emissions. WSRC-TR-99-00245

F. Evaluation Criterion weighted score (WS) for the Alternative: **$W_2 \times V_2$ = WS $\therefore$ .2 $\times$ 50 = 10.00**

Notes:

1. *For Level 1 Evaluation Criterion, the ID# is described by X.0, where X = 1, 2, 3,etc. For Level 2 Evaluation Criterion, the ID# is described by X.1, X.2, X.3, etc. where 'X' is the Level 1 Evaluation Criterion ID#.*

2. *Utility Function values range from 0 (least desirable) to 100 (most desirable).*

3. *If Level 2 Criterion are used, the sum of the Level 2 "Weighted Scores" must be multiplied by the Level 1 Weight to determine the Level 1 Weighted Score.*

HLW Salt Disposition Systems Engineering Team
Level 1 Evaluation Criteria Assessment Form

Alternative Number: 6 Alternative Title Crystalline Silicotitanate (CST) Ion Exchange - DWPF Vitrification

Date: 9/18/99

A. Evaluation Criterion Title: Engineering (Design)

Evaluation Criterion Description: Maximize the confidence that the facility meets applicable codes, standards & required production throughput.

B. Evaluation Criterion ID #: 5.0
(Note 1)

C. Evaluation Criterion Weighted Value: $\mathbf{W_1}$ = **.2**

D. Utility Functions:

Utility Function (UF) Value (V_1) = Σ Level 2 Criterion Weighted Score (WS)

(Note 2)

E. UF Value Formula: $\mathbf{V_1 = WS_{5.1} + WS_{5.2} + WS_{5.3} + WS_{5.4}}$
(Note 3)

F. Evaluation Criterion weighted score for the Alternative: $\mathbf{W_1 \times V_1}$ **= Weighted Score** ∴ **.2** × **52.50** = **10.50**

Explanatory Notes for Weighted Score:

Notes:

1. *For Level 1 Evaluation Criterion, the ID# is described by X.0, where X = 1, 2, 3,etc. For Level 2 Evaluation Criterion, the ID# is described by X.1, X.2, X.3, etc. where 'X' is the Level 1 Evaluation Criterion ID#.*
2. *Utility Function values range from 0 (least desirable) to 100 (most desirable).*
3. *If Level 2 Criterion are used, the sum of the Level 2 "Weighted Scores" must be multiplied by the Level 1 Weight to determine the Level 1 Weighted Score.*

HLW Salt Disposition Systems Engineering Team
Level 2 Evaluation Criteria Assessment Form

Alternative Number: 6 Alternative Title Crystalline Silicotitanate (CST) Ion Exchange - DWPF Vitrification

Date: 9/18/99

A. Evaluation Criterion Title: Construct

Evaluation Criterion Description: Ensure facility design considers major construction/testing methods and needs in accordance with Integrated Work Process (IWP) and Key Activities for Successful Execution (KASE).

B. Evaluation Criterion ID #: 5.1
(Note 1)

C. Evaluation Criterion Weighted Value: **W_2 = .25**

D. Utility Functions:

	Utility Function (UF) Description:	UF Value (Note 2)
UF.1	Facility design features and construction methods lead to simplicity of construction/testing process.	100
UF.2	Facility design features allows application of standard construction/testing practices (routine complexity).	60
UF.3	Facility design features and construction methods are difficult to apply due to non-standard, non-commercial methods not readily applied in radioactive environment.	0

E. **UF VALUE:** **V_2 = 40**

Explanatory Notes for UF Selected: Material handling complexity is increased with size reduced loaded resin. Modification within an operating facility is required for DWPF sampling systems and potentially melter feed system. WSRC-TR99-00309, WSRC-TR-99-00302.

F. Evaluation Criterion weighted score (WS) for the Alternative: **$W_2 \times V_2 = WS \therefore$ .25 $\times$ 40 = 10.00**

Notes:

1. *For Level 1 Evaluation Criterion, the ID# is described by X.0, where X = 1, 2, 3,etc. For Level 2 Evaluation Criterion, the ID# is described by X.1, X.2, X.3, etc. where 'X' is the Level 1 Evaluation Criterion ID#.*

2. *Utility Function values range from 0 (least desirable) to 100 (most desirable).*

3. *If Level 2 Criterion are used, the sum of the Level 2 "Weighted Scores" must be multiplied by the Level 1 Weight to determine the Level 1 Weighted Score.*

HLW Salt Disposition Systems Engineering Team
Level 2 Evaluation Criteria Assessment Form

Alternative Number: 6 Alternative Title Crystalline Silicotitanate (CST) Ion Exchange - DWPF Vitrification

Date: 9/18/99

A. Evaluation Criterion Title: Qualify

Evaluation Criterion Description: Readily validate defined functional design requirements, regulatory requirements, final disposal forms, and Authorization Basis (AB) safety requirements.

B. Evaluation Criterion ID #: (Note 1) 5.2

C. Evaluation Criterion Weighted Value: W_2 = **.25**

D. Utility Functions:

	Utility Function (UF) Description:	UF Value (Note 2)
UF.1	Test program has known acceptance criteria and accomodates direct verification of design attributes.	100
UF.2	Test program applies "Graded Approach" to verify key design attributes with other limited testing and inferred results.	70
UF.3	Insufficient science/engineering exists to establish firm test acceptance criteria and methods, limited direct verification.	0

E. **UF VALUE:** V_2 = **70**

Explanatory Notes for UF Selected: Interfacing with an operating facility will restrict some direct verification of design attributes. Hydrogen evolution rates in DWPF would be inferred through laboratory results.

F. Evaluation Criterion weighted score (WS) for the Alternative: $W_2 \times V_2 = WS \therefore$ **.25** $\times$ **70** = **17.50**

Notes:

1. *For Level 1 Evaluation Criterion, the ID# is described by X.0, where X = 1, 2, 3,etc. For Level 2 Evaluation Criterion, the ID# is described by X.1, X.2, X.3, etc. where 'X' is the Level 1 Evaluation Criterion ID#.*
2. *Utility Function values range from 0 (least desirable) to 100 (most desirable).*
3. *If Level 2 Criterion are used, the sum of the Level 2 "Weighted Scores" must be multiplied by the Level 1 Weight to determine the Level 1 Weighted Score.*

HLW Salt Disposition Systems Engineering Team
Level 2 Evaluation Criteria Assessment Form

Alternative Number: 6 Alternative Title Crystalline Silicotitanate (CST) Ion Exchange - DWPF Vitrification

Date: 9/18/99

A. Evaluation Criterion Title: Operate

Evaluation Criterion Description: Maximize ease of repeat operation/proceduralization, access for round sheets/physical verification, and upset operation management (Section R-1.4-3 of Functions & Requirements).

B. Evaluation Criterion ID #: (Note 1) 5.3

C. Evaluation Criterion Weighted Value: $\mathbf{W_2}$ = **.25**

D. Utility Functions:

	Utility Function (UF) Description:	UF Value (Note 2)
UF.1	Design allows simple, coordinated, straight forward operation with direct access to key controls, interlocks, and instruments. Easy access to key equipment, maximize ALARA considerations. Minimize number of process control points.	100
UF.2	Design allows manageable operation with minimal complexity (Standard SRS practice).	60
UF.3	Design is highly coupled with minimum holdup, multiple parallel operations and fast dynamics, and process instability.	0

E. **UF VALUE:** $\mathbf{V_2}$ = **50**

Explanatory Notes for UF Selected: Material handling is routine complexity. Additional operational restrictions for DWPF (glass formulation, sampling, resin grinder).

F. Evaluation Criterion weighted score (WS) for the Alternative: $\mathbf{W_2 \times V_2 = WS} \therefore$ **.25** × **50** = **12.50**

Notes:

1. *For Level 1 Evaluation Criterion, the ID# is described by X.0, where X = 1, 2, 3,etc. For Level 2 Evaluation Criterion, the ID# is described by X.1, X.2, X.3, etc. where 'X' is the Level 1 Evaluation Criterion ID#.*

2. *Utility Function values range from 0 (least desirable) to 100 (most desirable).*

3. *If Level 2 Criterion are used, the sum of the Level 2 "Weighted Scores" must be multiplied by the Level 1 Weight to determine the Level 1 Weighted Score.*

HLW Salt Disposition Systems Engineering Team
Level 2 Evaluation Criteria Assessment Form

Alternative Number: 6 Alternative Title Crystalline Silicotitanate (CST) Ion Exchange - DWPF Vitrification

Date: 9/18/99

A. Evaluation Criterion Title: RAMI

Evaluation Criterion Description: Design to maximize Reliability, Availability, Maintainability, and Inspectability.

B. Evaluation Criterion ID #: (Note 1) 5.4

C. Evaluation Criterion Weighted Value: $\mathbf{W_2}$ = **.25**

D. Utility Functions:

	Utility Function (UF) Description:	UF Value (Note 2)
UF.1	Design allows simple, coordinated, straight forward maintenance practices which take into account ALARA requirements. Design maximizes reliability, and availability of Structures, Systems, and Components.	100
UF.2	Design allows manageable maintenance functions with minimal complexibility (Standard SRS practice).	60
UF.3	Design complexity restricts maintainability and inspectability and reduces reliability, availability of Structures, Systems, and Components. Remoteability restricts maintainability.	0

E. **UF VALUE:** $\mathbf{V_2}$ = **50**

Explanatory Notes for UF Selected: Material handling concerns. Similar complexity to standard SRS practices. Alpha removal equipment size, temperature management and other unique equipment adds RAMI complexity.

F. Evaluation Criterion weighted score (WS) for the Alternative: $\mathbf{W_2 \times V_2 = WS} \therefore$ **.25** × **50** = **12.50**

Notes:

1. *For Level 1 Evaluation Criterion, the ID# is described by X.0, where X = 1, 2, 3,etc. For Level 2 Evaluation Criterion, the ID# is described by X.1, X.2, X.3, etc. where 'X' is the Level 1 Evaluation Criterion ID#.*

2. *Utility Function values range from 0 (least desirable) to 100 (most desirable).*

3. *If Level 2 Criterion are used, the sum of the Level 2 "Weighted Scores" must be multiplied by the Level 1 Weight to determine the Level 1 Weighted Score.*

HLW Salt Disposition Systems Engineering Team
Level 1 Evaluation Criteria Assessment Form

Alternative Number: 6 Alternative Title Crystalline Silicotitanate (CST) Ion Exchange - DWPF Vitrification

Date: 9/18/99

A. Evaluation Criterion Title: Cost/Schedule

Evaluation Criterion Description: Meet minimum combination of programmatic and technical risks and life cycle costs.

B. Evaluation Criterion ID #: 6.0
(Note 1)

C. Evaluation Criterion Weighted Value: $\mathbf{W_1}$ = **.12**

D. Utility Functions:

Utility Function (UF) Value (V_1) = Σ Level 2 Criterion Weighted Score (WS)

(Note 2)

E. UF Value Formula: $\mathbf{V_1 = WS_{6.1} + WS_{6.2} + WS_{6.3}}$
(Note 3)

F. Evaluation Criterion weighted score for the Alternative: $\mathbf{W_1 \times V_1}$ **= Weighted Score** ∴ **.12** × **81.00** = **9.72**

Explanatory Notes for Weighted Score:

Notes:

1. *For Level 1 Evaluation Criterion, the ID# is described by X.0, where X = 1, 2, 3,etc. For Level 2 Evaluation Criterion, the ID# is described by X.1, X.2, X.3, etc. where 'X' is the Level 1 Evaluation Criterion ID#.*
2. *Utility Function values range from 0 (least desirable) to 100 (most desirable).*
3. *If Level 2 Criterion are used, the sum of the Level 2 "Weighted Scores" must be multiplied by the Level 1 Weight to determine the Level 1 Weighted Score.*

HLW Salt Disposition Systems Engineering Team
Level 2 Evaluation Criteria Assessment Form

Alternative Number: 6 Alternative Title Crystalline Silicotitanate (CST) Ion Exchange - DWPF Vitrification

Date: 9/18/99

A. Evaluation Criterion Title: Regulatory Schedule Commitments

Evaluation Criterion Description: Maximize capability of disposing of radioactive wastes per Federal Facility Agreement (FFA) & Site Treatment Plan (STP) schedules or earlier.

B. Evaluation Criterion ID #: (Note 1) 6.1

C. Evaluation Criterion Weighted Value: $\mathbf{W_2}$ **= .5**

D. Utility Functions:

	Utility Function (UF) Description:	UF Value (Note 2)
UF.1	Accelerated Cleanup Plan (ACP) to empty High Level Waste (HLW) tanks by 2022 is met.	100
UF.2	Base Site Treatment Plan (STP) requirement to close HLW tanks by 2028 is met.	70
UF.3	Base STP or Federal Facility Agreement (FFA) requirements to close HLW tanks by committed dates is not met.	0

E. **UF VALUE:** $\mathbf{V_2}$ **= 80**

Explanatory Notes for UF Selected: DWPF operation supports STP requirement. Flexibility to expand throughput, but would not meet ACP.

F. Evaluation Criterion weighted score (WS) for the Alternative: $\mathbf{W_2 \times V_2 = WS \therefore .5 \times 80 = 40.00}$

Notes:

1. *For Level 1 Evaluation Criterion, the ID# is described by X.0, where X = 1, 2, 3,etc. For Level 2 Evaluation Criterion, the ID# is described by X.1, X.2, X.3, etc. where 'X' is the Level 1 Evaluation Criterion ID#.*

2. *Utility Function values range from 0 (least desirable) to 100 (most desirable).*

3. *If Level 2 Criterion are used, the sum of the Level 2 "Weighted Scores" must be multiplied by the Level 1 Weight to determine the Level 1 Weighted Score.*

HLW Salt Disposition Systems Engineering Team
Level 2 Evaluation Criteria Assessment Form

Alternative Number: 6 Alternative Title Crystalline Silicotitanate (CST) Ion Exchange - DWPF Vitrification

Date: 9/18/99

A. Evaluation Criterion Title: Life Cycle Costs (LCC)
Evaluation Criterion Description: Minimize LCC including TEC, OPC, and D&D (excludes salvage and repository costs).

B. Evaluation Criterion ID #: (Note 1) 6.2

C. Evaluation Criterion Weighted Value: **W_2 = .3**

D. Utility Functions:

	Utility Function (UF) Description:	UF Value (Note 2)
UF.1	LCC ≤ 2 billion dollars.	100
UF.2	LCC is 4 billion dollars.	50
UF.3	LCC is 8 billion dollars.	25
UF.4	LCC ≥ 16 billion dollars.	0

E. **UF VALUE:** **V_2 = 70**

Explanatory Notes for UF Selected: LCC equals 2.9 billion dollars. Based on the point estimate. WSRC-RP-98-00167

F. Evaluation Criterion weighted score (WS) for the Alternative: **$W_2 \times V_2$ = WS ∴ .3 × 70 = 21.00**

Notes:

1. *For Level 1 Evaluation Criterion, the ID# is described by X.0, where X = 1, 2, 3,etc. For Level 2 Evaluation Criterion, the ID# is described by X.1, X.2, X.3, etc. where 'X' is the Level 1 Evaluation Criterion ID#.*
2. *Utility Function values range from 0 (least desirable) to 100 (most desirable).*
3. *If Level 2 Criterion are used, the sum of the Level 2 "Weighted Scores" must be multiplied by the Level 1 Weight to determine the Level 1 Weighted Score.*

HLW Salt Disposition Systems Engineering Team
Level 2 Evaluation Criteria Assessment Form

Alternative Number: 6 Alternative Title Crystalline Silicotitanate (CST) Ion Exchange - DWPF Vitrification

Date: 9/18/99

A. Evaluation Criterion Title: Repository Costs

Evaluation Criterion Description: Minimize cost for waste disposal off-site (Federal Repository).

B. Evaluation Criterion ID #: (Note 1) 6.3

C. Evaluation Criterion Weighted Value: $\mathbf{W_2}$ = **.2**

D. Utility Functions:

Utility Function (UF) Description:		UF Value (Note 2)
UF.1	≤ 6000 canisters for off-site disposal	100
UF.2	68,000 canisters for off-site disposal.	50
UF.3	≥ 130,000 canisters for off-site disposal	0

E. **UF VALUE:** $\mathbf{V_2}$ = **100**

Explanatory Notes for UF Selected: DWPF canister production remains at 6000.

F. Evaluation Criterion weighted score (WS) for the Alternative: $\mathbf{W_2 \times V_2 = WS} \therefore$ **.2** × **100** = **20.00**

Notes:

1. *For Level 1 Evaluation Criterion, the ID# is described by X.0, where X = 1, 2, 3,etc. For Level 2 Evaluation Criterion, the ID# is described by X.1, X.2, X.3, etc. where 'X' is the Level 1 Evaluation Criterion ID#.*
2. *Utility Function values range from 0 (least desirable) to 100 (most desirable).*
3. *If Level 2 Criterion are used, the sum of the Level 2 "Weighted Scores" must be multiplied by the Level 1 Weight to determine the Level 1 Weighted Score.*

7.1.3 Direct Disposal in Grout

HLW Salt Disposition Systems Engineering Team
Level 1 Evaluation Criteria Assessment Form

Alternative Number: 18 Alternative Title Direct Disposal to Grout

Date: 9/18/99

A. Evaluation Criterion Title: Technology

Evaluation Criterion Description: Maximize the confidence that underlying scientific principles & engineering implementation will result in adequate attainment.

B. Evaluation Criterion ID #: 1.0
(Note 1)

C. Evaluation Criterion Weighted Value: $\mathbf{W_1}$ = **.23**

D. Utility Functions:

Utility Function (UF) Value (V_1) = Σ Level 2 Criterion Weighted Score (WS)

(Note 2)

E. UF Value Formula: $\mathbf{V_1 = WS_{1.1} + WS_{1.2} + WS_{1.3}}$
(Note 3)

F. Evaluation Criterion weighted score for the Alternative: $\mathbf{W_1 \times V_1}$ **= Weighted Score ∴ .23 × 86.00 = 19.78**

Explanatory Notes for Weighted Score:

Notes:

1. *For Level 1 Evaluation Criterion, the ID# is described by X.0, where X = 1, 2, 3,etc. For Level 2 Evaluation Criterion, the ID# is described by X.1, X.2, X.3, etc. where 'X' is the Level 1 Evaluation Criterion ID#.*

2. *Utility Function values range from 0 (least desirable) to 100 (most desirable).*

3. *If Level 2 Criterion are used, the sum of the Level 2 "Weighted Scores" must be multiplied by the Level 1 Weight to determine the Level 1 Weighted Score.*

HLW Salt Disposition Systems Engineering Team
Level 2 Evaluation Criteria Assessment Form

Alternative Number: 18 Alternative Title Direct Disposal to Grout

Date: 9/18/99

A. Evaluation Criterion Title: Scientific Maturity

Evaluation Criterion Description: The level of scientific understanding needed to minimize project risk.

B. Evaluation Criterion ID #: (Note 1) 1.1

C. Evaluation Criterion Weighted Value: **W_2 = .4**

D. Utility Functions:

	Utility Function (UF) Description:	UF Value (Note 2)
UF.1	Reliable radioactive production scale demonstration & correlation to predicted scientific results.	100
UF.2	Large scale radioactive test; 'spiked' radiochemistry demonstration.	80
UF.3	Pilot (small) scale radioactive test; full radiochemistry.	40
UF.4	Lab scale test; simulant/real waste.	10
UF.5	Theoretical understanding only; no practical demonstration.	0.0

E. **UF VALUE:** **V_2 = 95**

Explanatory Notes for UF Selected: Grout formulation changes to address the potassium and cesium difference from the existing Saltstone process.

F. Evaluation Criterion weighted score (WS) for the Alternative: **$W_2 \times V_2 = WS \therefore$ .4 $\times$ 95 = 38.00**

Notes:

1. *For Level 1 Evaluation Criterion, the ID# is described by X.0, where X = 1, 2, 3,etc. For Level 2 Evaluation Criterion, the ID# is described by X.1, X.2, X.3, etc. where 'X' is the Level 1 Evaluation Criterion ID#.*
2. *Utility Function values range from 0 (least desirable) to 100 (most desirable).*
3. *If Level 2 Criterion are used, the sum of the Level 2 "Weighted Scores" must be multiplied by the Level 1 Weight to determine the Level 1 Weighted Score.*

HLW Salt Disposition Systems Engineering Team
Level 2 Evaluation Criteria Assessment Form

Alternative Number: 18 Alternative Title Direct Disposal to Grout

Date: 9/18/99

A. Evaluation Criterion Title: Engineering Maturity

Evaluation Criterion Description: The level of applied engineering concepts needed to minimize project risk.

B. Evaluation Criterion ID #: (Note 1) 1.2

C. Evaluation Criterion Weighted Value: W_2 = **.4**

D. Utility Functions:

	Utility Function (UF) Description:	UF Value (Note 2)
UF.1	Reliable radioactive production scale with significant operating experience.	100
UF.2	Reliable non-radioactive production scale with significant operating experience.	60
UF.3	Limited radioactive production scale.	40
UF.4	Limited non-radioactive production scale	20
UF.5	Demonstration	0

E. **UF VALUE:** V_2 = **70**

Explanatory Notes for UF Selected: SRS Saltstone, BNFL Sellafield, West Valley, and Oak Ridge experience. Alpha removal process provides some engineering challenges in the areas of filtration, mixing and pumping. WSRC-TR-99-00342; WSRC-RP-99-0006.

F. Evaluation Criterion weighted score (WS) for the Alternative: $W_2 \times V_2 = WS \therefore$ **.4** × **70** = **28.00**

Notes:

1. *For Level 1 Evaluation Criterion, the ID# is described by X.0, where X = 1, 2, 3,etc. For Level 2 Evaluation Criterion, the ID# is described by X.1, X.2, X.3, etc. where 'X' is the Level 1 Evaluation Criterion ID#.*

2. *Utility Function values range from 0 (least desirable) to 100 (most desirable).*

3. *If Level 2 Criterion are used, the sum of the Level 2 "Weighted Scores" must be multiplied by the Level 1 Weight to determine the Level 1 Weighted Score.*

HLW Salt Disposition Systems Engineering Team
Level 2 Evaluation Criteria Assessment Form

Alternative Number: 18 Alternative Title Direct Disposal to Grout

Date: 9/18/99

A. Evaluation Criterion Title: Process Simplicity

Evaluation Criterion Description: Ease of Science implementation understanding by operators.

B. Evaluation Criterion ID #: (Note 1) 1.3

C. Evaluation Criterion Weighted Value: $\mathbf{W_2}$ = **.2**

D. Utility Functions:

	Utility Function (UF) Description:	UF Value (Note 2)
UF.1	Low complexity, straight forward operations.	100
UF.2	Moderate complexity - operator aids and routine engineering support.	70
UF.3	Complex - significant training for operators and continuous, specialized engineering support required.	0.0

E. **UF VALUE:** $\mathbf{V_2}$ = **100**

Explanatory Notes for UF Selected: Intrinsic process simplicity and much operating experience.

F. Evaluation Criterion weighted score (WS) for the Alternative: $\mathbf{W_2 \times V_2 = WS \therefore .2 \times 100 = 20.00}$

Notes:

1. *For Level 1 Evaluation Criterion, the ID# is described by X.0, where X = 1, 2, 3,etc. For Level 2 Evaluation Criterion, the ID# is described by X.1, X.2, X.3, etc. where 'X' is the Level 1 Evaluation Criterion ID#.*
2. *Utility Function values range from 0 (least desirable) to 100 (most desirable).*
3. *If Level 2 Criterion are used, the sum of the Level 2 "Weighted Scores" must be multiplied by the Level 1 Weight to determine the Level 1 Weighted Score.*

HLW Salt Disposition Systems Engineering Team
Level 1 Evaluation Criteria Assessment Form

Alternative Number: 18 Alternative Title Direct Disposal to Grout

Date: 9/18/99

A. Evaluation Criterion Title: Current Mission Interfaces

Evaluation Criterion Description: Impact on current SRS missions/programs.

B. Evaluation Criterion ID #: (Note 1) 2.0

C. Evaluation Criterion Weighted Value: $\mathbf{W_1}$ = **.15**

D. Utility Functions:

Utility Function (UF) Value (V_1) = Σ Level 2 Criterion Weighted Score (WS)

(Note 2)

E. UF Value Formula: (Note 3) $\mathbf{V_1 = WS_{2.1} + WS_{2.2} + WS_{2.3} + WS_{2.4} + WS_{2.5}}$

F. Evaluation Criterion weighted score for the Alternative: $\mathbf{W_1 \times V_1}$ **= Weighted Score** ∴ **.15** × **78.25** = **11.74**

Explanatory Notes for Weighted Score:

Notes:

1. *For Level 1 Evaluation Criterion, the ID# is described by X.0, where X = 1, 2, 3,etc. For Level 2 Evaluation Criterion, the ID# is described by X.1, X.2, X.3, etc. where 'X' is the Level 1 Evaluation Criterion ID#.*

2. *Utility Function values range from 0 (least desirable) to 100 (most desirable).*

3. *If Level 2 Criterion are used, the sum of the Level 2 "Weighted Scores" must be multiplied by the Level 1 Weight to determine the Level 1 Weighted Score.*

HLW Salt Disposition Systems Engineering Team
Level 2 Evaluation Criteria Assessment Form

Alternative Number: 18 Alternative Title Direct Disposal to Grout

Date: 9/18/99

A. Evaluation Criterion Title: DWPF

Evaluation Criterion Description: Impact on DWPF (Table 1 Functions & Requirements).

B. Evaluation Criterion ID #: (Note 1) 2.1

C. Evaluation Criterion Weighted Value: **W_2 = .25**

D. Utility Functions:

	Utility Function (UF) Description:	UF Value (Note 2)
UF.1	Sludge only to completion	100
UF.2	Sludge plus MST to completion.	85
UF.3	Baseline - current ITP flowsheet.	70
UF.4	Moderate impact - some additional canisters (< 50%). Facility modifications required.	20
UF.5	Significant impact - additional canisters (>50%) glass reformulation/repermitting required. Major facility modifications required.	0

E. **UF VALUE:** **V_2 = 85**

Explanatory Notes for UF Selected: Flowsheet basis uses MST for TRU separation.

F. Evaluation Criterion weighted score (WS) for the Alternative: **$W_2 \times V_2 = WS \therefore .25 \times 85 = 21.25$**

Notes:

1. *For Level 1 Evaluation Criterion, the ID# is described by X.0, where X = 1, 2, 3,etc. For Level 2 Evaluation Criterion, the ID# is described by X.1, X.2, X.3, etc. where 'X' is the Level 1 Evaluation Criterion ID#.*

2. *Utility Function values range from 0 (least desirable) to 100 (most desirable).*

3. *If Level 2 Criterion are used, the sum of the Level 2 "Weighted Scores" must be multiplied by the Level 1 Weight to determine the Level 1 Weighted Score.*

HLW Salt Disposition Systems Engineering Team
Level 2 Evaluation Criteria Assessment Form

Alternative Number: 18 Alternative Title Direct Disposal to Grout

Date: 9/18/99

A. Evaluation Criterion Title: Saltstone

Evaluation Criterion Description: Impact on Saltstone (Table 1 Functions & Requirements).

B. Evaluation Criterion ID #: (Note 1) 2.2

C. Evaluation Criterion Weighted Value: W_2 = **.15**

D. Utility Functions:

	Utility Function (UF) Description:	UF Value (Note 2)
UF.1	No need for Saltstone Facility.	100
UF.2	Reduced throughput required to Saltstone Facility. No hazards release (Benzene).	80
UF.3	180M gallons saltstone plus Benzene risk (current flowsheet).	70
UF.4	Moderate increase in saltstone (<50%). Minor facility modifications.	40
UF.5	Repermit saltstone to Class C waste. Major facility modifications and increased throughtput (>50%).	0

E. **UF VALUE:** V_2 = **100**

Explanatory Notes for UF Selected: New facility eliminates the need for the existing Saltstone facility (results in retirement)

F. Evaluation Criterion weighted score (WS) for the Alternative: $W_2 \times V_2 = WS \therefore$ **.15** × **100** = **15.00**

Notes:

1. *For Level 1 Evaluation Criterion, the ID# is described by X.0, where X = 1, 2, 3,etc. For Level 2 Evaluation Criterion, the ID# is described by X.1, X.2, X.3, etc. where 'X' is the Level 1 Evaluation Criterion ID#.*

2. *Utility Function values range from 0 (least desirable) to 100 (most desirable).*

3. *If Level 2 Criterion are used, the sum of the Level 2 "Weighted Scores" must be multiplied by the Level 1 Weight to determine the Level 1 Weighted Score.*

HLW Salt Disposition Systems Engineering Team
Level 2 Evaluation Criteria Assessment Form

Alternative Number: 18 Alternative Title Direct Disposal to Grout

Date: 9/18/99

A. Evaluation Criterion Title: Solid Waste

Evaluation Criterion Description: Impact on Solid Waste (Table 1 Functions & Requirements).

B. Evaluation Criterion ID #: (Note 1) 2.3

C. Evaluation Criterion Weighted Value: **W_2 = .1**

D. Utility Functions:

Utility Function (UF) Description:		UF Value (Note 2)
UF.1	Reduced solid waste volume and no Benzene.	100
UF.2	Reduced solid waste volume and Benzene.	80
UF.3	Current flowsheet (Benzene to CIF).	50
UF.4	Moderate increase in solid waste volume.	30
UF.5	Repermit new waste forms, significant increase in solid waste volume.	0

E. **UF VALUE:** **V_2 = 80**

Explanatory Notes for UF Selected: No increase in equipment or job control waste to be handled by Solid Waste Division vaults (excluding saltstone grout). Reduction in liquid benzene generation by 35,000 gallons per year (no benzene generated).

F. Evaluation Criterion weighted score (WS) for the Alternative: **$W_2 \times V_2$ = WS $\therefore$ .1 × 80 = 8.00**

Notes:

1. *For Level 1 Evaluation Criterion, the ID# is described by X.0, where X = 1, 2, 3,etc. For Level 2 Evaluation Criterion, the ID# is described by X.1, X.2, X.3, etc. where 'X' is the Level 1 Evaluation Criterion ID#.*

2. *Utility Function values range from 0 (least desirable) to 100 (most desirable).*

3. *If Level 2 Criterion are used, the sum of the Level 2 "Weighted Scores" must be multiplied by the Level 1 Weight to determine the Level 1 Weighted Score.*

HLW Salt Disposition Systems Engineering Team
Level 2 Evaluation Criteria Assessment Form

Alternative Number: 18 Alternative Title Direct Disposal to Grout

Date: 9/18/99

A. Evaluation Criterion Title: Tank Farm

Evaluation Criterion Description: Impact on Tank Farm (Table 1 Functions & Requirements).

B. Evaluation Criterion ID #: (Note 1) 2.4

C. Evaluation Criterion Weighted Value: **W_2 = .2**

D. Utility Functions:

	Utility Function (UF) Description:	UF Value (Note 2)
UF.1	Reduced safety hazards, improved operability of tank farm (no blending). Reduced corrosion control impact.	100
UF.2	Current flowsheet.	50
UF.3	Increased safety hazards (e.g. Organics) increase operational capacity, increased corrosion impacts.	0

E. **UF VALUE:** **V_2 = 80**

Explanatory Notes for UF Selected: Based on not operating a precipitate process through DWPF there is no benzene or cesium in the recycle and a reduction in recycle water volume and subsequent impact on corrosion control. Reduced evaporator operations. WSRC-RP-98-00168, R1

F. Evaluation Criterion weighted score (WS) for the Alternative: **$W_2 \times V_2 = WS \therefore .2 \times 80 = 16.00$**

Notes:

1. *For Level 1 Evaluation Criterion, the ID# is described by X.0, where X = 1, 2, 3,etc. For Level 2 Evaluation Criterion, the ID# is described by X.1, X.2, X.3, etc. where 'X' is the Level 1 Evaluation Criterion ID#.*

2. *Utility Function values range from 0 (least desirable) to 100 (most desirable).*

3. *If Level 2 Criterion are used, the sum of the Level 2 "Weighted Scores" must be multiplied by the Level 1 Weight to determine the Level 1 Weighted Score.*

HLW Salt Disposition Systems Engineering Team
Level 2 Evaluation Criteria Assessment Form

Alternative Number: 18 Alternative Title Direct Disposal to Grout

Date: 9/18/99

A. Evaluation Criterion Title: Tank Farm Space Management

Evaluation Criterion Description: Utilization of available Tank Farm storage & resources as a function of time (HLW Salt Disposition Interface Functional Performance Requirement).

B. Evaluation Criterion ID #: (Note 1) 2.5

C. Evaluation Criterion Weighted Value: $\mathbf{W_2}$ = **.3**

D. Utility Functions:

Utility Function (UF) Description:		UF Value (Note 2)
UF.1	Accelerate tank space gain. Tank space adequate for current and future missions.	100
UF.2	Current flowsheet (reduces available tank space)	40
UF.3	Accelerated reduction in available tank space (water logged tank farm).	0

E. **UF VALUE:** $\mathbf{V_2}$ = **60**

Explanatory Notes for UF Selected: DWPF recycle is reduced by 500,000 gallons per year due to no precipitate hydrolysis process. Salt solution work off rate is 17.5 gpm. TK49 readily available for waste storage. TK48 available after waste handling strategy is completed. WSRC-RP-98-00168, R1; WSRC-RP-99-00005

F. Evaluation Criterion weighted score (WS) for the Alternative: $\mathbf{W_2 \times V_2 = WS \therefore .3 \times 60 = 18.00}$

Notes:

1. *For Level 1 Evaluation Criterion, the ID# is described by X.0, where X = 1, 2, 3,etc. For Level 2 Evaluation Criterion, the ID# is described by X.1, X.2, X.3, etc. where 'X' is the Level 1 Evaluation Criterion ID#.*
2. *Utility Function values range from 0 (least desirable) to 100 (most desirable).*
3. *If Level 2 Criterion are used, the sum of the Level 2 "Weighted Scores" must be multiplied by the Level 1 Weight to determine the Level 1 Weighted Score.*

HLW Salt Disposition Systems Engineering Team
Level 1 Evaluation Criteria Assessment Form

Alternative Number: 18 Alternative Title Direct Disposal to Grout

Date: 9/18/99

A. Evaluation Criterion Title: Future Mission Interfaces

Evaluation Criterion Description: Maximize the support of identified potential future missions.

B. Evaluation Criterion ID #: (Note 1) 3.0

C. Evaluation Criterion Weighted Value: **W_1 = .07**

D. Utility Functions:

	Utility Function (UF) Description:	UF Value (Note 2)
UF.1	Flexible system capable of supporting identified potential future missions.	100
UF.2	System will support can-in-can and spent fuel stabilization.	70
UF.3	System will not support can-in-can or spent fuel stabilization.	0

E. **UF VALUE:** **V_1 = 35**

Explanatory Notes for UF Selected: Based on technical viability to support spent fuel stabilization. Does not support can-in-can mission because cesium does not go to DWPF.

F. Evaluation Criterion weighted score (WS) for the Alternative: **$W_1 \times V_1 = WS \therefore .07 \times 35 = 2.45$**

Notes:

1. *For Level 1 Evaluation Criterion, the ID# is described by X.0, where X = 1, 2, 3,etc. For Level 2 Evaluation Criterion, the ID# is described by X.1, X.2, X.3, etc. where 'X' is the Level 1 Evaluation Criterion ID#.*
2. *Utility Function values range from 0 (least desirable) to 100 (most desirable).*
3. *If Level 2 Criterion are used, the sum of the Level 2 "Weighted Scores" must be multiplied by the Level 1 Weight to determine the Level 1 Weighted Score.*

HLW Salt Disposition Systems Engineering Team
Level 1 Evaluation Criteria Assessment Form

Alternative Number: 18 Alternative Title Direct Disposal to Grout

Date: 9/18/99

A. Evaluation Criterion Title: Regulatory/ISMS/Environmental

Evaluation Criterion Description: Protect personnel & the environment from hazards & releases of waste & pollution by ensuring maximum application of intrinsic safety features.

B. Evaluation Criterion ID #: 4.0
(Note 1)

C. Evaluation Criterion Weighted Value: **W_1 = .23**

D. Utility Functions:

Utility Function (UF) Value (V_1) = Σ Level 2 Criterion Weighted Score (WS)

(Note 2)

E. UF Value Formula: **$V_1 = WS_{4.1} + WS_{4.2} + WS_{4.3}$**
(Note 3)

F. Evaluation Criterion weighted score for the Alternative: **$W_1 \times V_1$ = Weighted Score ∴ .23 × 49.00 = 11.27**

Explanatory Notes for Weighted Score:

Notes:

1. *For Level 1 Evaluation Criterion, the ID# is described by X.0, where X = 1, 2, 3,etc. For Level 2 Evaluation Criterion, the ID# is described by X.1, X.2, X.3, etc. where 'X' is the Level 1 Evaluation Criterion ID#.*

2. *Utility Function values range from 0 (least desirable) to 100 (most desirable).*

3. *If Level 2 Criterion are used, the sum of the Level 2 "Weighted Scores" must be multiplied by the Level 1 Weight to determine the Level 1 Weighted Score.*

HLW Salt Disposition Systems Engineering Team

Level 2 Evaluation Criteria Assessment Form

Alternative Number: 18 Alternative Title Direct Disposal to Grout

Date: 9/18/99

A. Evaluation Criterion Title: Public/Environment

Evaluation Criterion Description: Protect the public & environment from hazards & accidental releases of waste & pollution by ensuring maximum application of intrinsic safety features.

B. Evaluation Criterion ID #: 4.1
(Note 1)

C. Evaluation Criterion Weighted Value: $\mathbf{W_2}$ = **.45**

D. Utility Functions:

	Utility Function (UF) Description:	UF Value (Note 2)
UF.1	Process is inherently safe and can be quantified/documented in Authorization Basis.	100
UF.2	Process has moderate hazards that are passively mitigated.	85
UF.3	Process has moderate hazards that are readily mitigated.	60
UF.4	Process has inherent hazards that can be mitigated with Engineered Safety Features and Administrative Controls.	35
UF.5	Process has inherent hazards and the risks are not quantifiable.	0

E. **UF VALUE:** $\mathbf{V_2}$ = **60**

Explanatory Notes for UF Selected: Hydrogen source in alpha removal tank provides energy for source term dispersion. WSRC-RP-98-00168, R1; S-CLC-G-00187

F. Evaluation Criterion weighted score (WS) for the Alternative: $\mathbf{W_2 \times V_2 = WS \therefore}$ **.45** × **60** = **27.00**

Notes:

1. *For Level 1 Evaluation Criterion, the ID# is described by X.0, where X = 1, 2, 3,etc. For Level 2 Evaluation Criterion, the ID# is described by X.1, X.2, X.3, etc. where 'X' is the Level 1 Evaluation Criterion ID#.*

2. *Utility Function values range from 0 (least desirable) to 100 (most desirable).*

3. *If Level 2 Criterion are used, the sum of the Level 2 "Weighted Scores" must be multiplied by the Level 1 Weight to determine the Level 1 Weighted Score.*

HLW Salt Disposition Systems Engineering Team
Level 2 Evaluation Criteria Assessment Form

Alternative Number: 18 Alternative Title Direct Disposal to Grout

Date: 9/18/99

A. Evaluation Criterion Title: Worker

Evaluation Criterion Description: Protect on-site personnel from hazards & accidental releases of waste & pollution by ensuring maximum application of intrinsic safety features.

B. Evaluation Criterion ID #: (Note 1) 4.2

C. Evaluation Criterion Weighted Value: $\mathbf{W_2}$ = **.35**

D. Utility Functions:

	Utility Function (UF) Description:	UF Value (Note 2)
UF.1	Process is inherently safe and poses no unusual worker safety hazard.	100
UF.2	Process has moderate hazards that are passively mitigated.	80
UF.3	Process has moderate hazards that are readily mitigated.	60
UF.4	Process has inherent hazards that can be mitigated with Structures, Systems, Components and Administrative Controls.	40
UF.5	Process has inherent hazards and poses significant risk to worker safety that are not readily mitigated.	0

E. **UF VALUE:** $\mathbf{V_2}$ = **60**

Explanatory Notes for UF Selected: Hydrogen source in alpha removal tank provides energy for source term dispersion. WSRC-RP-98-00168, R1; S-CLC-G-00187.

F. Evaluation Criterion weighted score (WS) for the Alternative: $\mathbf{W_2 \times V_2 = WS \therefore}$ **.35** × **60** = **21.00**

Notes:

1. *For Level 1 Evaluation Criterion, the ID# is described by X.0, where X = 1, 2, 3,etc. For Level 2 Evaluation Criterion, the ID# is described by X.1, X.2, X.3, etc. where 'X' is the Level 1 Evaluation Criterion ID#.*

2. *Utility Function values range from 0 (least desirable) to 100 (most desirable).*

3. *If Level 2 Criterion are used, the sum of the Level 2 "Weighted Scores" must be multiplied by the Level 1 Weight to determine the Level 1 Weighted Score.*

HLW Salt Disposition Systems Engineering Team
Level 2 Evaluation Criteria Assessment Form

Alternative Number: 18 Alternative Title Direct Disposal to Grout

Date: 9/18/99

A. Evaluation Criterion Title: Permitting

Evaluation Criterion Description: Minimize waste generation risk & difficulty of permitting new releases & waste forms.

B. Evaluation Criterion ID #: (Note 1) 4.3

C. Evaluation Criterion Weighted Value: **W_2 = .2**

D. Utility Functions:

	Utility Function (UF) Description:	UF Value (Note 2)
UF.1	No new waste forms requiring permitting, eliminate one or more existing releases, no requalification of existing waste forms.	100
UF.2	Reduction in current releases, no additional permitting required.	80
UF.3	Current flowsheet (Saltstone Facility needs repermitting due to Benzene releases).	60
UF.4	Requalification of existing waste form, exceeds current release levels.	20
UF.5	New waste form permit required, significant increase in environmental releases requiring repermitting, high level waste retained in South Carolina	0

E. **UF VALUE:** **V_2 = 5**

Explanatory Notes for UF Selected: Grout considered new waste form of high level waste retained in South Carolina. Eliminates benzene releases.

F. Evaluation Criterion weighted score (WS) for the Alternative: **$W_2 \times V_2$ = WS ∴ .2 × 5 = 1.00**

Notes:

1. *For Level 1 Evaluation Criterion, the ID# is described by X.0, where X = 1, 2, 3,etc. For Level 2 Evaluation Criterion, the ID# is described by X.1, X.2, X.3, etc. where 'X' is the Level 1 Evaluation Criterion ID#.*

2. *Utility Function values range from 0 (least desirable) to 100 (most desirable).*

3. *If Level 2 Criterion are used, the sum of the Level 2 "Weighted Scores" must be multiplied by the Level 1 Weight to determine the Level 1 Weighted Score.*

HLW Salt Disposition Systems Engineering Team
Level 1 Evaluation Criteria Assessment Form

Alternative Number: 18 Alternative Title Direct Disposal to Grout

Date: 9/18/99

A. Evaluation Criterion Title: Engineering (Design)

Evaluation Criterion Description: Maximize the confidence that the facility meets applicable codes, standards & required production throughput.

B. Evaluation Criterion ID #: 5.0
(Note 1)

C. Evaluation Criterion Weighted Value: $\mathbf{W_1} =$ **.2**

D. Utility Functions:

Utility Function (UF) Value (V_1) = Σ Level 2 Criterion Weighted Score (WS)

(Note 2)

E. UF Value Formula: $\mathbf{V_1 = WS_{5.1} + WS_{5.2} + WS_{5.3} + WS_{5.4}}$
(Note 3)

F. Evaluation Criterion weighted score for the Alternative: $\mathbf{W_1 \times V_1}$ **= Weighted Score** ∴ **.2** × **92.50** = **18.50**

Explanatory Notes for Weighted Score:

Notes:

1. *For Level 1 Evaluation Criterion, the ID# is described by X.0, where X = 1, 2, 3,etc. For Level 2 Evaluation Criterion, the ID# is described by X.1, X.2, X.3, etc. where 'X' is the Level 1 Evaluation Criterion ID#.*

2. *Utility Function values range from 0 (least desirable) to 100 (most desirable).*

3. *If Level 2 Criterion are used, the sum of the Level 2 "Weighted Scores" must be multiplied by the Level 1 Weight to determine the Level 1 Weighted Score.*

HLW Salt Disposition Systems Engineering Team
Level 2 Evaluation Criteria Assessment Form

Alternative Number: 18 Alternative Title Direct Disposal to Grout

Date: 9/18/99

A. Evaluation Criterion Title: Construct

Evaluation Criterion Description: Ensure facility design considers major construction/testing methods and needs in accordance with Integrated Work Process (IWP) and Key Activities for Successful Execution (KASE).

B. Evaluation Criterion ID #: (Note 1) 5.1

C. Evaluation Criterion Weighted Value: W_2 = **.25**

D. Utility Functions:

	Utility Function (UF) Description:	UF Value (Note 2)
UF.1	Facility design features and construction methods lead to simplicity of construction/testing process.	100
UF.2	Facility design features allows application of standard construction/testing practices (routine complexity).	60
UF.3	Facility design features and construction methods are difficult to apply due to non-standard, non-commercial methods not readily applied in radioactive environment.	0

E. **UF VALUE:** V_2 = **100**

Explanatory Notes for UF Selected: Straight forward process currently in use at SRS.

F. Evaluation Criterion weighted score (WS) for the Alternative: $W_2 \times V_2 = WS \therefore$ **.25** $\times$ **100** = **25.00**

Notes:

1. *For Level 1 Evaluation Criterion, the ID# is described by X.0, where X = 1, 2, 3,etc. For Level 2 Evaluation Criterion, the ID# is described by X.1, X.2, X.3, etc. where 'X' is the Level 1 Evaluation Criterion ID#.*

2. *Utility Function values range from 0 (least desirable) to 100 (most desirable).*

3. *If Level 2 Criterion are used, the sum of the Level 2 "Weighted Scores" must be multiplied by the Level 1 Weight to determine the Level 1 Weighted Score.*

HLW Salt Disposition Systems Engineering Team
Level 2 Evaluation Criteria Assessment Form

Alternative Number: 18 Alternative Title Direct Disposal to Grout

Date: 9/18/99

A. Evaluation Criterion Title: Qualify

Evaluation Criterion Description: Readily validate defined functional design requirements, regulatory requirements, final disposal forms, and Authorization Basis (AB) safety requirements.

B. Evaluation Criterion ID #: (Note 1) 5.2

C. Evaluation Criterion Weighted Value: **W_2 = .25**

D. Utility Functions:

	Utility Function (UF) Description:	UF Value (Note 2)
UF.1	Test program has known acceptance criteria and accomodates direct verification of design attributes.	100
UF.2	Test program applies "Graded Approach" to verify key design attributes with other limited testing and inferred results.	70
UF.3	Insufficient science/engineering exists to establish firm test acceptance criteria and methods, limited direct verification.	0

E. **UF VALUE:** **V_2 = 90**

Explanatory Notes for UF Selected: Grout analysis not specified to support verification of grout formulation.

F. Evaluation Criterion weighted score (WS) for the Alternative: **$W_2 \times V_2 = WS \therefore .25 \times 90 = 22.50$**

Notes:

1. *For Level 1 Evaluation Criterion, the ID# is described by X.0, where X = 1, 2, 3,etc. For Level 2 Evaluation Criterion, the ID# is described by X.1, X.2, X.3, etc. where 'X' is the Level 1 Evaluation Criterion ID#.*

2. *Utility Function values range from 0 (least desirable) to 100 (most desirable).*

3. *If Level 2 Criterion are used, the sum of the Level 2 "Weighted Scores" must be multiplied by the Level 1 Weight to determine the Level 1 Weighted Score.*

HLW Salt Disposition Systems Engineering Team
Level 2 Evaluation Criteria Assessment Form

Alternative Number: 18 Alternative Title Direct Disposal to Grout

Date: 9/18/99

A. Evaluation Criterion Title: Operate

Evaluation Criterion Description: Maximize ease of repeat operation/proceduralization, access for round sheets/physical verification, and upset operation management (Section R-1.4-3 of Functions & Requirements).

B. Evaluation Criterion ID #: (Note 1) 5.3

C. Evaluation Criterion Weighted Value: **W_2 = .25**

D. Utility Functions:

	Utility Function (UF) Description:	UF Value (Note 2)
UF.1	Design allows simple, coordinated, straight forward operation with direct access to key controls, interlocks, and instruments. Easy access to key equipment, maximize ALARA considerations. Minimize number of process control points.	100
UF.2	Design allows manageable operation with minimal complexity (Standard SRS practice).	60
UF.3	Design is highly coupled with minimum holdup, multiple parallel operations and fast dynamics, and process instability.	0

E. **UF VALUE:** **V_2 = 100**

Explanatory Notes for UF Selected: Simple straight forward process.

F. Evaluation Criterion weighted score (WS) for the Alternative: **$W_2 \times V_2 = WS \therefore$ .25 $\times$ 100 = 25.00**

Notes:

1. *For Level 1 Evaluation Criterion, the ID# is described by X.0, where X = 1, 2, 3,etc. For Level 2 Evaluation Criterion, the ID# is described by X.1, X.2, X.3, etc. where 'X' is the Level 1 Evaluation Criterion ID#.*

2. *Utility Function values range from 0 (least desirable) to 100 (most desirable).*

3. *If Level 2 Criterion are used, the sum of the Level 2 "Weighted Scores" must be multiplied by the Level 1 Weight to determine the Level 1 Weighted Score.*

HLW Salt Disposition Systems Engineering Team
Level 2 Evaluation Criteria Assessment Form

Alternative Number: 18 Alternative Title Direct Disposal to Grout

Date: 9/18/99

A. Evaluation Criterion Title: RAMI

Evaluation Criterion Description: Design to maximize Reliability, Availability, Maintainability, and Inspectability.

B. Evaluation Criterion ID #: (Note 1) 5.4

C. Evaluation Criterion Weighted Value: $\mathbf{W_2}$ = **.25**

D. Utility Functions:

	Utility Function (UF) Description:	UF Value (Note 2)
UF.1	Design allows simple, coordinated, straight forward maintenance practices which take into account ALARA requirements. Design maximizes reliability, and availability of Structures, Systems, and Components.	100
UF.2	Design allows manageable maintenance functions with minimal complexibility (Standard SRS practice).	60
UF.3	Design complexity restricts maintainability and inspectability and reduces reliability, availability of Structures, Systems, and Components. Remotability restricts maintainability.	0

E. **UF VALUE:** $\mathbf{V_2}$ = **80**

Explanatory Notes for UF Selected: Minimal equipment with "in-canyon" service. Simple unit operations. Alpha removal equipment size adds RAMI complexity. WSRC-RP-99-006

F. Evaluation Criterion weighted score (WS) for the Alternative: $\mathbf{W_2 \times V_2 = WS} \therefore$ **.25** × **80** = **20.00**

Notes:

1. *For Level 1 Evaluation Criterion, the ID# is described by X.0, where X = 1, 2, 3,etc. For Level 2 Evaluation Criterion, the ID# is described by X.1, X.2, X.3, etc. where 'X' is the Level 1 Evaluation Criterion ID#.*

2. *Utility Function values range from 0 (least desirable) to 100 (most desirable).*

3. *If Level 2 Criterion are used, the sum of the Level 2 "Weighted Scores" must be multiplied by the Level 1 Weight to determine the Level 1 Weighted Score.*

HLW Salt Disposition Systems Engineering Team
Level 1 Evaluation Criteria Assessment Form

Alternative Number: 18 Alternative Title Direct Disposal to Grout

Date: 9/18/99

A. Evaluation Criterion Title: Cost/Schedule

Evaluation Criterion Description: Meet minimum combination of programmatic and technical risks and life cycle costs.

B. Evaluation Criterion ID #: 6.0
(Note 1)

C. Evaluation Criterion Weighted Value: $\mathbf{W_1}$ = **.12**

D. Utility Functions:

Utility Function (UF) Value (V_1) = Σ Level 2 Criterion Weighted Score (WS)

(Note 2)

E. UF Value Formula: $\mathbf{V_1 = WS_{6.1} + WS_{6.2} + WS_{6.3}}$
(Note 3)

F. Evaluation Criterion weighted score for the Alternative: $\mathbf{W_1 \times V_1}$ **= Weighted Score** ∴ **.12** × **55.00** = **6.60**

Explanatory Notes for Weighted Score:

Notes:

1. *For Level 1 Evaluation Criterion, the ID# is described by X.0, where X = 1, 2, 3,etc. For Level 2 Evaluation Criterion, the ID# is described by X.1, X.2, X.3, etc. where 'X' is the Level 1 Evaluation Criterion ID#.*

2. *Utility Function values range from 0 (least desirable) to 100 (most desirable).*

3. *If Level 2 Criterion are used, the sum of the Level 2 "Weighted Scores" must be multiplied by the Level 1 Weight to determine the Level 1 Weighted Score.*

HLW Salt Disposition Systems Engineering Team
Level 2 Evaluation Criteria Assessment Form

Alternative Number: 18 Alternative Title Direct Disposal to Grout

Date: 9/18/99

A. Evaluation Criterion Title: Regulatory Schedule Commitments

Evaluation Criterion Description: Maximize capability of disposing of radioactive wastes per Federal Facility Agreement (FFA) & Site Treatment Plan (STP) schedules or earlier.

B. Evaluation Criterion ID #: (Note 1) 6.1

C. Evaluation Criterion Weighted Value: **W_2 = .5**

D. Utility Functions:

Utility Function (UF) Description:		UF Value (Note 2)
UF.1	Accelerated Cleanup Plan (ACP) to empty High Level Waste (HLW) tanks by 2022 is met.	100
UF.2	Base Site Treatment Plan (STP) requirement to close HLW tanks by 2028 is met.	70
UF.3	Base STP or Federal Facility Agreement (FFA) requirements to close HLW tanks by committed dates is not met.	0

E. **UF VALUE:** **V_2 = 10**

Explanatory Notes for UF Selected: Licensing the SRS as a high level waste repository. Yucca Mountain has been unsuccessful in being licensed for 20 years.

F. Evaluation Criterion weighted score (WS) for the Alternative: **$W_2 \times V_2 = WS \therefore .5 \times 10 = 5.00$**

Notes:

1. *For Level 1 Evaluation Criterion, the ID# is described by X.0, where X = 1, 2, 3,etc. For Level 2 Evaluation Criterion, the ID# is described by X.1, X.2, X.3, etc. where 'X' is the Level 1 Evaluation Criterion ID#.*

2. *Utility Function values range from 0 (least desirable) to 100 (most desirable).*

3. *If Level 2 Criterion are used, the sum of the Level 2 "Weighted Scores" must be multiplied by the Level 1 Weight to determine the Level 1 Weighted Score.*

HLW Salt Disposition Systems Engineering Team
Level 2 Evaluation Criteria Assessment Form

Alternative Number: 18 Alternative Title Direct Disposal to Grout

Date: 9/18/99

A. Evaluation Criterion Title: Life Cycle Costs (LCC)

Evaluation Criterion Description: Minimize LCC including TEC, OPC, and D&D (excludes salvage and repository costs).

B. Evaluation Criterion ID #: (Note 1) 6.2

C. Evaluation Criterion Weighted Value: $\mathbf{W_2}$ = **.3**

D. Utility Functions:

	Utility Function (UF) Description:	UF Value (Note 2)
UF.1	LCC ≤ 2 billion dollars.	100
UF.2	LCC is 4 billion dollars.	50
UF.3	LCC is 8 billion dollars.	25
UF.4	LCC ≥ 16 billion dollars.	0

E. **UF VALUE:** $\mathbf{V_2}$ = **100**

Explanatory Notes for UF Selected: LCC equals 20 billion dollars. Based on the point estimate. WSRC-RP-98-00167

F. Evaluation Criterion weighted score (WS) for the Alternative: $\mathbf{W_2 \times V_2 = WS \;\therefore\; .3 \times 100 = 30.00}$

Notes:

1. *For Level 1 Evaluation Criterion, the ID# is described by X.0, where X = 1, 2, 3,etc. For Level 2 Evaluation Criterion, the ID# is described by X.1, X.2, X.3, etc. where 'X' is the Level 1 Evaluation Criterion ID#.*

2. *Utility Function values range from 0 (least desirable) to 100 (most desirable).*

3. *If Level 2 Criterion are used, the sum of the Level 2 "Weighted Scores" must be multiplied by the Level 1 Weight to determine the Level 1 Weighted Score.*

HLW Salt Disposition Systems Engineering Team
Level 2 Evaluation Criteria Assessment Form

Alternative Number: 18 Alternative Title Direct Disposal to Grout

Date: 9/18/99

A. Evaluation Criterion Title: Repository Costs

Evaluation Criterion Description: Minimize cost for waste disposal off-site (Federal Repository).

B. Evaluation Criterion ID #: (Note 1) 6.3

C. Evaluation Criterion Weighted Value: $\mathbf{W_2}$ = **.2**

D. Utility Functions:

Utility Function (UF) Description:		UF Value (Note 2)
UF.1	≤ 6000 canisters for off-site disposal	100
UF.2	68,000 canisters for off-site disposal.	50
UF.3	≥ 130,000 canisters for off-site disposal	0

E. **UF VALUE:** $\mathbf{V_2}$ = **100**

Explanatory Notes for UF Selected: DWPF canister production remains at 6000.

F. Evaluation Criterion weighted score (WS) for the Alternative: $\mathbf{W_2 \times V_2 = WS \;\therefore\; .2 \times 100 = 20.00}$

Notes:

1. *For Level 1 Evaluation Criterion, the ID# is described by X.0, where X = 1, 2, 3,etc. For Level 2 Evaluation Criterion, the ID# is described by X.1, X.2, X.3, etc. where 'X' is the Level 1 Evaluation Criterion ID#.*
2. *Utility Function values range from 0 (least desirable) to 100 (most desirable).*
3. *If Level 2 Criterion are used, the sum of the Level 2 "Weighted Scores" must be multiplied by the Level 1 Weight to determine the Level 1 Weighted Score.*

7.1.4 Small Tank TPB Precipitation

HLW Salt Disposition Systems Engineering Team
Level 1 Evaluation Criteria Assessment Form

Alternative Number: 13 Alternative Title Small Tank TPB Precipitation

Date: 9/18/99

A. Evaluation Criterion Title: Technology

Evaluation Criterion Description: Maximize the confidence that underlying scientific principles & engineering implementation will result in adequate attainment.

B. Evaluation Criterion ID #: 1.0
(Note 1)

C. Evaluation Criterion Weighted Value: $\mathbf{W_1}$ = **.23**

D. Utility Functions:

Utility Function (UF) Value (V_1) = Σ Level 2 Criterion Weighted Score (WS)

(Note 2)

E. UF Value Formula: $\mathbf{V_1 = WS_{1.1} + WS_{1.2} + WS_{1.3}}$
(Note 3)

F. Evaluation Criterion weighted score for the Alternative: $\mathbf{W_1 \times V_1}$ **= Weighted Score** ∴ **.23** × **78.00** = **17.94**

Explanatory Notes for Weighted Score:

Notes:

1. *For Level 1 Evaluation Criterion, the ID# is described by X.0, where X = 1, 2, 3,etc. For Level 2 Evaluation Criterion, the ID# is described by X.1, X.2, X.3, etc. where 'X' is the Level 1 Evaluation Criterion ID#.*

2. *Utility Function values range from 0 (least desirable) to 100 (most desirable).*

3. *If Level 2 Criterion are used, the sum of the Level 2 "Weighted Scores" must be multiplied by the Level 1 Weight to determine the Level 1 Weighted Score.*

HLW Salt Disposition Systems Engineering Team
Level 2 Evaluation Criteria Assessment Form

Alternative Number: 13 Alternative Title Small Tank TPB Precipitation

Date: 9/18/99

A. Evaluation Criterion Title: Scientific Maturity

Evaluation Criterion Description: The level of scientific understanding needed to minimize project risk.

B. Evaluation Criterion ID #: (Note 1) 1.1

C. Evaluation Criterion Weighted Value: W_2 = **.4**

D. Utility Functions:

	Utility Function (UF) Description:	UF Value (Note 2)
UF.1	Reliable radioactive production scale demonstration & correlation to predicted scientific results.	100
UF.2	Large scale radioactive test; 'spiked' radiochemistry demonstration.	80
UF.3	Pilot (small) scale radioactive test; full radiochemistry.	40
UF.4	Lab scale test; simulant/real waste.	10
UF.5	Theoretical understanding only; no practical demonstration.	0.0

E. **UF VALUE:** V_2 = **80**

Explanatory Notes for UF Selected: ITP radioactive demonstration runs. DNFSB 96-1 SRTC laboratory work. 20L CSTR closed loop "spiked" radiochemistry demonstration. Precipitate foaming observed during radioactive CSTR bench scale test confirmed the need for anti-foam development. TPB recovery efficiency was 1/3 of expectation.

F. Evaluation Criterion weighted score (WS) for the Alternative: $W_2 \times V_2 = WS \therefore$ **.4** $\times$ **80** = **32.00**

Notes:

1. *For Level 1 Evaluation Criterion, the ID# is described by X.0, where X = 1, 2, 3,etc. For Level 2 Evaluation Criterion, the ID# is described by X.1, X.2, X.3, etc. where 'X' is the Level 1 Evaluation Criterion ID#.*

2. *Utility Function values range from 0 (least desirable) to 100 (most desirable).*

3. *If Level 2 Criterion are used, the sum of the Level 2 "Weighted Scores" must be multiplied by the Level 1 Weight to determine the Level 1 Weighted Score.*

HLW Salt Disposition Systems Engineering Team
Level 2 Evaluation Criteria Assessment Form

Alternative Number: 13 Alternative Title Small Tank TPB Precipitation

Date: 9/18/99

A. Evaluation Criterion Title: Engineering Maturity

Evaluation Criterion Description: The level of applied engineering concepts needed to minimize project risk.

B. Evaluation Criterion ID #: (Note 1) 1.2

C. Evaluation Criterion Weighted Value: **W_2 = .4**

D. Utility Functions:

	Utility Function (UF) Description:	UF Value (Note 2)
UF.1	Reliable radioactive production scale with significant operating experience.	100
UF.2	Reliable non-radioactive production scale with significant operating experience.	60
UF.3	Limited radioactive production scale.	40
UF.4	Limited non-radioactive production scale	20
UF.5	Demonstration	0

E. **UF VALUE:** **V_2 = 80**

Explanatory Notes for UF Selected: ITP filter radioactive production scale operation. 20L CSTR closed loop "spiked" radiochemistry demonstration confirms continuous precipitation. Testing at various scales has indicated a need to address NaTPB dispersion.

F. Evaluation Criterion weighted score (WS) for the Alternative: **$W_2 \times V_2 = WS \therefore .4 \times 80 = 32.00$**

Notes:

1. *For Level 1 Evaluation Criterion, the ID# is described by X.0, where X = 1, 2, 3,etc. For Level 2 Evaluation Criterion, the ID# is described by X.1, X.2, X.3, etc. where 'X' is the Level 1 Evaluation Criterion ID#.*

2. *Utility Function values range from 0 (least desirable) to 100 (most desirable).*

3. *If Level 2 Criterion are used, the sum of the Level 2 "Weighted Scores" must be multiplied by the Level 1 Weight to determine the Level 1 Weighted Score.*

HLW Salt Disposition Systems Engineering Team
Level 2 Evaluation Criteria Assessment Form

Alternative Number: 13 Alternative Title Small Tank TPB Precipitation

Date: 9/18/99

A. Evaluation Criterion Title: Process Simplicity

Evaluation Criterion Description: Ease of Science implementation understanding by operators.

B. Evaluation Criterion ID #: (Note 1) 1.3

C. Evaluation Criterion Weighted Value: $\mathbf{W_2}$ = **.2**

D. Utility Functions:

	Utility Function (UF) Description:	UF Value (Note 2)
UF.1	Low complexity, straight forward operations.	100
UF.2	Moderate complexity - operator aids and routine engineering support.	70
UF.3	Complex - significant training for operators and continuous, specialized engineering support required.	0.0

E. **UF VALUE:** $\mathbf{V_2}$ = **70**

Explanatory Notes for UF Selected: Similar operations to salt and chemical cells operations at DWPF, monitoring temperatures, flows, and product productions. WSRC-RP-99-00005; HLW-SDT-99-0266.

F. Evaluation Criterion weighted score (WS) for the Alternative: $\mathbf{W_2 \times V_2 = WS \therefore .2 \times 70 = 14.00}$

Notes:

1. *For Level 1 Evaluation Criterion, the ID# is described by X.0, where X = 1, 2, 3,etc. For Level 2 Evaluation Criterion, the ID# is described by X.1, X.2, X.3, etc. where 'X' is the Level 1 Evaluation Criterion ID#.*

2. *Utility Function values range from 0 (least desirable) to 100 (most desirable).*

3. *If Level 2 Criterion are used, the sum of the Level 2 "Weighted Scores" must be multiplied by the Level 1 Weight to determine the Level 1 Weighted Score.*

HLW Salt Disposition Systems Engineering Team
Level 1 Evaluation Criteria Assessment Form

Alternative Number: 13 Alternative Title Small Tank TPB Precipitation

Date: 9/18/99

A. Evaluation Criterion Title: Current Mission Interfaces

Evaluation Criterion Description: Impact on current SRS missions/programs.

B. Evaluation Criterion ID #: (Note 1) 2.0

C. Evaluation Criterion Weighted Value: $\mathbf{W_1 =}$ **.15**

D. Utility Functions:

Utility Function (UF) Value (V_1) = Σ Level 2 Criterion Weighted Score (WS)

(Note 2)

E. UF Value Formula: (Note 3) $\mathbf{V_1 = WS_{2.1} + WS_{2.2} + WS_{2.3} + WS_{2.4} + WS_{2.5}}$

F. Evaluation Criterion weighted score for the Alternative: $\mathbf{W_1 \times V_1}$ **= Weighted Score** ∴ **.15** × **65.50** = **9.82**

Explanatory Notes for Weighted Score:

Notes:

1. *For Level 1 Evaluation Criterion, the ID# is described by X.0, where X = 1, 2, 3,etc. For Level 2 Evaluation Criterion, the ID# is described by X.1, X.2, X.3, etc. where 'X' is the Level 1 Evaluation Criterion ID#.*

2. *Utility Function values range from 0 (least desirable) to 100 (most desirable).*

3. *If Level 2 Criterion are used, the sum of the Level 2 "Weighted Scores" must be multiplied by the Level 1 Weight to determine the Level 1 Weighted Score.*

HLW Salt Disposition Systems Engineering Team
Level 2 Evaluation Criteria Assessment Form

Alternative Number: 13 Alternative Title Small Tank TPB Precipitation

Date: 9/18/99

A. Evaluation Criterion Title: DWPF

Evaluation Criterion Description: Impact on DWPF (Table 1 Functions & Requirements).

B. Evaluation Criterion ID #: (Note 1) 2.1

C. Evaluation Criterion Weighted Value: **W_2 = .25**

D. Utility Functions:

	Utility Function (UF) Description:	UF Value (Note 2)
UF.1	Sludge only to completion	100
UF.2	Sludge plus MST to completion.	85
UF.3	Baseline - current ITP flowsheet.	70
UF.4	Moderate impact - some additional canisters (< 50%). Facility modifications required.	20
UF.5	Significant impact - additional canisters (>50%) glass reformulation/repermitting required. Major facility modifications required.	0

E. **UF VALUE:** **V_2 = 85**

Explanatory Notes for UF Selected: Precipitate hydrolysis process removed from DWPF. Sludge, MST, and PHA streams. The product stream provides a soft interface with DWPF.

F. Evaluation Criterion weighted score (WS) for the Alternative: **$W_2 \times V_2 = WS \therefore$ .25 $\times$ 85 = 21.25**

Notes:

1. *For Level 1 Evaluation Criterion, the ID# is described by X.0, where X = 1, 2, 3,etc. For Level 2 Evaluation Criterion, the ID# is described by X.1, X.2, X.3, etc. where 'X' is the Level 1 Evaluation Criterion ID#.*

2. *Utility Function values range from 0 (least desirable) to 100 (most desirable).*

3. *If Level 2 Criterion are used, the sum of the Level 2 "Weighted Scores" must be multiplied by the Level 1 Weight to determine the Level 1 Weighted Score.*

HLW Salt Disposition Systems Engineering Team
Level 2 Evaluation Criteria Assessment Form

Alternative Number: 13 Alternative Title Small Tank TPB Precipitation

Date: 9/18/99

A. Evaluation Criterion Title: Saltstone

Evaluation Criterion Description: Impact on Saltstone (Table 1 Functions & Requirements).

B. Evaluation Criterion ID #: (Note 1) 2.2

C. Evaluation Criterion Weighted Value: **W_2 = .15**

D. Utility Functions:

	Utility Function (UF) Description:	UF Value (Note 2)
UF.1	No need for Saltstone Facility.	100
UF.2	Reduced throughput required to Saltstone Facility. No hazards release (Benzene).	80
UF.3	180M gallons saltstone plus Benzene risk (current flowsheet).	70
UF.4	Moderate increase in saltstone (<50%). Minor facility modifications.	40
UF.5	Repermit saltstone to Class C waste. Major facility modifications and increased throughtput (>50%).	0

E. **UF VALUE:** **V_2 = 75**

Explanatory Notes for UF Selected: Reduced benzene release.

F. Evaluation Criterion weighted score (WS) for the Alternative: **$W_2 \times V_2 = WS \therefore$ .15 × 75 = 11.25**

Notes:

1. *For Level 1 Evaluation Criterion, the ID# is described by X.0, where X = 1, 2, 3,etc. For Level 2 Evaluation Criterion, the ID# is described by X.1, X.2, X.3, etc. where 'X' is the Level 1 Evaluation Criterion ID#.*
2. *Utility Function values range from 0 (least desirable) to 100 (most desirable).*
3. *If Level 2 Criterion are used, the sum of the Level 2 "Weighted Scores" must be multiplied by the Level 1 Weight to determine the Level 1 Weighted Score.*

HLW Salt Disposition Systems Engineering Team
Level 2 Evaluation Criteria Assessment Form

Alternative Number: 13 Alternative Title Small Tank TPB Precipitation

Date: 9/18/99

A. Evaluation Criterion Title: Solid Waste

Evaluation Criterion Description: Impact on Solid Waste (Table 1 Functions & Requirements).

B. Evaluation Criterion ID #: (Note 1) 2.3

C. Evaluation Criterion Weighted Value: W_2 = **.1**

D. Utility Functions:

	Utility Function (UF) Description:	UF Value (Note 2)
UF.1	Reduced solid waste volume and no Benzene.	100
UF.2	Reduced solid waste volume and Benzene.	80
UF.3	Current flowsheet (Benzene to CIF).	50
UF.4	Moderate increase in solid waste volume.	30
UF.5	Repermit new waste forms, significant increase in solid waste volume.	0

E. **UF VALUE:** V_2 = **50**

Explanatory Notes for UF Selected: Comparable to current flowsheet.

F. Evaluation Criterion weighted score (WS) for the Alternative: $W_2 \times V_2 = WS \therefore$ **.1** × **50** = **5.00**

Notes:

1. *For Level 1 Evaluation Criterion, the ID# is described by X.0, where X = 1, 2, 3,etc. For Level 2 Evaluation Criterion, the ID# is described by X.1, X.2, X.3, etc. where 'X' is the Level 1 Evaluation Criterion ID#.*

2. *Utility Function values range from 0 (least desirable) to 100 (most desirable).*

3. *If Level 2 Criterion are used, the sum of the Level 2 "Weighted Scores" must be multiplied by the Level 1 Weight to determine the Level 1 Weighted Score.*

HLW Salt Disposition Systems Engineering Team
Level 2 Evaluation Criteria Assessment Form

Alternative Number: 13 Alternative Title Small Tank TPB Precipitation

Date: 9/18/99

A. Evaluation Criterion Title: Tank Farm

Evaluation Criterion Description: Impact on Tank Farm (Table 1 Functions & Requirements).

B. Evaluation Criterion ID #: (Note 1) 2.4

C. Evaluation Criterion Weighted Value: W_2 = **.2**

D. Utility Functions:

	Utility Function (UF) Description:	UF Value (Note 2)
UF.1	Reduced safety hazards, improved operability of tank farm (no blending). Reduced corrosion control impact.	100
UF.2	Current flowsheet.	50
UF.3	Increased safety hazards (e.g. Organics) increase operational capacity, increased corrosion impacts.	0

E. **UF VALUE:** V_2 = **50**

Explanatory Notes for UF Selected: Comparable to current flowsheet..

F. Evaluation Criterion weighted score (WS) for the Alternative: $W_2 \times V_2 = WS \therefore$ **.2** × **50** = **10.00**

Notes:

1. *For Level 1 Evaluation Criterion, the ID# is described by X.0, where X = 1, 2, 3,etc. For Level 2 Evaluation Criterion, the ID# is described by X.1, X.2, X.3, etc. where 'X' is the Level 1 Evaluation Criterion ID#.*
2. *Utility Function values range from 0 (least desirable) to 100 (most desirable).*
3. *If Level 2 Criterion are used, the sum of the Level 2 "Weighted Scores" must be multiplied by the Level 1 Weight to determine the Level 1 Weighted Score.*

HLW Salt Disposition Systems Engineering Team
Level 2 Evaluation Criteria Assessment Form

Alternative Number: 13 Alternative Title Small Tank TPB Precipitation

Date: 9/18/99

A. Evaluation Criterion Title: Tank Farm Space Management

Evaluation Criterion Description: Utilization of available Tank Farm storage & resources as a function of time (HLW Salt Disposition Interface Functional Performance Requirement).

B. Evaluation Criterion ID #: (Note 1) 2.5

C. Evaluation Criterion Weighted Value: $\mathbf{W_2}$ = **.3**

D. Utility Functions:

	Utility Function (UF) Description:	UF Value (Note 2)
UF.1	Accelerate tank space gain. Tank space adequate for current and future missions.	100
UF.2	Current flowsheet (reduces available tank space)	40
UF.3	Accelerated reduction in available tank space (water logged tank farm).	0

E. **UF VALUE:** $\mathbf{V_2}$ = **60**

Explanatory Notes for UF Selected: TK49 readily available for waste storage. TK48 available after waste handling strategy completed (could be processed by this flowsheet). WSRC-RP-99-0005; WSRC-RP-99-0006

F. Evaluation Criterion weighted score (WS) for the Alternative: $\mathbf{W_2 \times V_2 = WS \therefore}$ **.3** × **60** = **18.00**

Notes:

1. *For Level 1 Evaluation Criterion, the ID# is described by X.0, where X = 1, 2, 3,etc. For Level 2 Evaluation Criterion, the ID# is described by X.1, X.2, X.3, etc. where 'X' is the Level 1 Evaluation Criterion ID#.*
2. *Utility Function values range from 0 (least desirable) to 100 (most desirable).*
3. *If Level 2 Criterion are used, the sum of the Level 2 "Weighted Scores" must be multiplied by the Level 1 Weight to determine the Level 1 Weighted Score.*

HLW Salt Disposition Systems Engineering Team
Level 1 Evaluation Criteria Assessment Form

Alternative Number: 13 Alternative Title Small Tank TPB Precipitation

Date: 9/18/99

A. Evaluation Criterion Title: Future Mission Interfaces

Evaluation Criterion Description: Maximize the support of identified potential future missions.

B. Evaluation Criterion ID #: (Note 1) 3.0

C. Evaluation Criterion Weighted Value: $\mathbf{W_1}$ = **.07**

D. Utility Functions:

	Utility Function (UF) Description:	UF Value (Note 2)
UF.1	Flexible system capable of supporting identified potential future missions.	100
UF.2	System will support can-in-can and spent fuel stabilization.	70
UF.3	System will not support can-in-can or spent fuel stabilization.	0

E. **UF VALUE:** $\mathbf{V_1}$ = **70**

Explanatory Notes for UF Selected: Cesium loading supports can-in-can mission. Tank space gain supports spent fuel stabilization mission.

F. Evaluation Criterion weighted score (WS) for the Alternative: $\mathbf{W_1 \times V_1 = WS \therefore}$ **.07** × **70** = **4.90**

Notes:

1. *For Level 1 Evaluation Criterion, the ID# is described by X.0, where X = 1, 2, 3,etc. For Level 2 Evaluation Criterion, the ID# is described by X.1, X.2, X.3, etc. where 'X' is the Level 1 Evaluation Criterion ID#.*
2. *Utility Function values range from 0 (least desirable) to 100 (most desirable).*
3. *If Level 2 Criterion are used, the sum of the Level 2 "Weighted Scores" must be multiplied by the Level 1 Weight to determine the Level 1 Weighted Score.*

HLW Salt Disposition Systems Engineering Team
Level 1 Evaluation Criteria Assessment Form

Alternative Number: 13 Alternative Title Small Tank TPB Precipitation

Date: 9/18/99

A. Evaluation Criterion Title: Regulatory/ISMS/Environmental

Evaluation Criterion Description: Protect personnel & the environment from hazards & releases of waste & pollution by ensuring maximum application of intrinsic safety features.

B. Evaluation Criterion ID #: 4.0
(Note 1)

C. Evaluation Criterion Weighted Value: $\mathbf{W_1}$ = **.23**

D. Utility Functions:

Utility Function (UF) Value (V_1) = Σ Level 2 Criterion Weighted Score (WS)

(Note 2)

E. UF Value Formula: $\mathbf{V_1 = WS_{4.1} + WS_{4.2} + WS_{4.3}}$
(Note 3)

F. Evaluation Criterion weighted score for the Alternative: $\mathbf{W_1 \times V_1}$ **= Weighted Score** ∴ **.23** × **66.00** = **15.18**

Explanatory Notes for Weighted Score:

Notes:

1. *For Level 1 Evaluation Criterion, the ID# is described by X.0, where X = 1, 2, 3,etc. For Level 2 Evaluation Criterion, the ID# is described by X.1, X.2, X.3, etc. where 'X' is the Level 1 Evaluation Criterion ID#.*

2. *Utility Function values range from 0 (least desirable) to 100 (most desirable).*

3. *If Level 2 Criterion are used, the sum of the Level 2 "Weighted Scores" must be multiplied by the Level 1 Weight to determine the Level 1 Weighted Score.*

HLW Salt Disposition Systems Engineering Team
Level 2 Evaluation Criteria Assessment Form

Alternative Number: 13 Alternative Title Small Tank TPB Precipitation

Date: 9/18/99

A. Evaluation Criterion Title: Public/Environment

Evaluation Criterion Description: Protect the public & environment from hazards & accidental releases of waste & pollution by ensuring maximum application of intrinsic safety features.

B. Evaluation Criterion ID #: 4.1
(Note 1)

C. Evaluation Criterion Weighted Value: **W_2 = .45**

D. Utility Functions:

	Utility Function (UF) Description:	UF Value (Note 2)
UF.1	Process is inherently safe and can be quantified/documented in Authorization Basis.	100
UF.2	Process has moderate hazards that are passively mitigated.	85
UF.3	Process has moderate hazards that are readily mitigated.	60
UF.4	Process has inherent hazards that can be mitigated with Engineered Safety Features and Administrative Controls.	35
UF.5	Process has inherent hazards and the risks are not quantifiable.	0

E. **UF VALUE:** **V_2 = 60**

Explanatory Notes for UF Selected: Lower source term and lower energy source.

F. Evaluation Criterion weighted score (WS) for the Alternative: **$W_2 \times V_2$ = WS ∴ .45 × 60 = 27.00**

Notes:

1. *For Level 1 Evaluation Criterion, the ID# is described by X.0, where X = 1, 2, 3,etc. For Level 2 Evaluation Criterion, the ID# is described by X.1, X.2, X.3, etc. where 'X' is the Level 1 Evaluation Criterion ID#.*

2. *Utility Function values range from 0 (least desirable) to 100 (most desirable).*

3. *If Level 2 Criterion are used, the sum of the Level 2 "Weighted Scores" must be multiplied by the Level 1 Weight to determine the Level 1 Weighted Score.*

HLW Salt Disposition Systems Engineering Team
Level 2 Evaluation Criteria Assessment Form

Alternative Number: 13 Alternative Title Small Tank TPB Precipitation

Date: 9/18/99

A. Evaluation Criterion Title: Worker

Evaluation Criterion Description: Protect on-site personnel from hazards & accidental releases of waste & pollution by ensuring maximum application of intrinsic safety features.

B. Evaluation Criterion ID #: (Note 1) 4.2

C. Evaluation Criterion Weighted Value: **W_2 = .35**

D. Utility Functions:

	Utility Function (UF) Description:	UF Value (Note 2)
UF.1	Process is inherently safe and poses no unusual worker safety hazard.	100
UF.2	Process has moderate hazards that are passively mitigated.	80
UF.3	Process has moderate hazards that are readily mitigated.	60
UF.4	Process has inherent hazards that can be mitigated with Structures, Systems, Components and Administrative Controls.	40
UF.5	Process has inherent hazards and poses significant risk to worker safety that are not readily mitigated.	0

E. **UF VALUE:** **V_2 = 60**

Explanatory Notes for UF Selected: Reduced benzene releases. Precipitate hydrolysis process operation.

F. Evaluation Criterion weighted score (WS) for the Alternative: **$W_2 \times V_2$ = WS ∴ .35 × 60 = 21.00**

Notes:

1. *For Level 1 Evaluation Criterion, the ID# is described by X.0, where X = 1, 2, 3,etc. For Level 2 Evaluation Criterion, the ID# is described by X.1, X.2, X.3, etc. where 'X' is the Level 1 Evaluation Criterion ID#.*

2. *Utility Function values range from 0 (least desirable) to 100 (most desirable).*

3. *If Level 2 Criterion are used, the sum of the Level 2 "Weighted Scores" must be multiplied by the Level 1 Weight to determine the Level 1 Weighted Score.*

HLW Salt Disposition Systems Engineering Team
Level 2 Evaluation Criteria Assessment Form

Alternative Number: 13 Alternative Title Small Tank TPB Precipitation

Date: 9/18/99

A. Evaluation Criterion Title: Permitting

Evaluation Criterion Description: Minimize waste generation risk & difficulty of permitting new releases & waste forms.

B. Evaluation Criterion ID #: 4.3
(Note 1)

C. Evaluation Criterion Weighted Value: $\mathbf{W_2}$ = **.2**

D. Utility Functions:

	Utility Function (UF) Description:	UF Value (Note 2)
UF.1	No new waste forms requiring permitting, eliminate one or more existing releases, no requalification of existing waste forms.	100
UF.2	Reduction in current releases, no additional permitting required.	80
UF.3	Current flowsheet (Saltstone Facility needs repermitting due to Benzene releases).	60
UF.4	Requalification of existing waste form, exceeds current release levels.	20
UF.5	New waste form permit required, significant increase in environmental releases requiring repermitting, high level waste retained in South Carolina	0

E. **UF VALUE:** $\mathbf{V_2}$ = **90**

Explanatory Notes for UF Selected: Reduce benzene releases. No requalification of DWPF glass.

F. Evaluation Criterion weighted score (WS) for the Alternative: $\mathbf{W_2 \times V_2 = WS \therefore}$ **.2** × **90** = **18.00**

Notes:

1. *For Level 1 Evaluation Criterion, the ID# is described by X.0, where X = 1, 2, 3,etc. For Level 2 Evaluation Criterion, the ID# is described by X.1, X.2, X.3, etc. where 'X' is the Level 1 Evaluation Criterion ID#.*

2. *Utility Function values range from 0 (least desirable) to 100 (most desirable).*

3. *If Level 2 Criterion are used, the sum of the Level 2 "Weighted Scores" must be multiplied by the Level 1 Weight to determine the Level 1 Weighted Score.*

HLW Salt Disposition Systems Engineering Team
Level 1 Evaluation Criteria Assessment Form

Alternative Number: 13 Alternative Title Small Tank TPB Precipitation

Date: 9/18/99

A. Evaluation Criterion Title: Engineering (Design)

Evaluation Criterion Description: Maximize the confidence that the facility meets applicable codes, standards & required production throughput.

B. Evaluation Criterion ID #: 5.0
(Note 1)

C. Evaluation Criterion Weighted Value: $\mathbf{W_1}$ = **.2**

D. Utility Functions:

Utility Function (UF) Value (V_1) = Σ Level 2 Criterion Weighted Score (WS)

(Note 2)

E. UF Value Formula: $\mathbf{V_1 = WS_{5.1} + WS_{5.2} + WS_{5.3} + WS_{5.4}}$
(Note 3)

F. Evaluation Criterion weighted score for the Alternative: $\mathbf{W_1 \times V_1}$ **= Weighted Score** ∴ **.2** × **70.00** = **14.00**

Explanatory Notes for Weighted Score:

Notes:

1. *For Level 1 Evaluation Criterion, the ID# is described by X.0, where X = 1, 2, 3,etc. For Level 2 Evaluation Criterion, the ID# is described by X.1, X.2, X.3, etc. where 'X' is the Level 1 Evaluation Criterion ID#.*

2. *Utility Function values range from 0 (least desirable) to 100 (most desirable).*

3. *If Level 2 Criterion are used, the sum of the Level 2 "Weighted Scores" must be multiplied by the Level 1 Weight to determine the Level 1 Weighted Score.*

HLW Salt Disposition Systems Engineering Team
Level 2 Evaluation Criteria Assessment Form

Alternative Number: 13 Alternative Title Small Tank TPB Precipitation

Date: 9/18/99

A. Evaluation Criterion Title: Construct

Evaluation Criterion Description: Ensure facility design considers major construction/testing methods and needs in accordance with Integrated Work Process (IWP) and Key Activities for Successful Execution (KASE).

B. Evaluation Criterion ID #: (Note 1) 5.1

C. Evaluation Criterion Weighted Value: $\mathbf{W_2}$ = **.25**

D. Utility Functions:

	Utility Function (UF) Description:	UF Value (Note 2)
UF.1	Facility design features and construction methods lead to simplicity of construction/testing process.	100
UF.2	Facility design features allows application of standard construction/testing practices (routine complexity).	60
UF.3	Facility design features and construction methods are difficult to apply due to non-standard, non-commercial methods not readily applied in radioactive environment.	0

E. **UF VALUE:** $\mathbf{V_2}$ = **80**

Explanatory Notes for UF Selected: Multiple unit operations coupled together.

F. Evaluation Criterion weighted score (WS) for the Alternative: $\mathbf{W_2 \times V_2 = WS} \therefore$ **.25** × **80** = **20.00**

Notes:

1. *For Level 1 Evaluation Criterion, the ID# is described by X.0, where X = 1, 2, 3,etc. For Level 2 Evaluation Criterion, the ID# is described by X.1, X.2, X.3, etc. where 'X' is the Level 1 Evaluation Criterion ID#.*

2. *Utility Function values range from 0 (least desirable) to 100 (most desirable).*

3. *If Level 2 Criterion are used, the sum of the Level 2 "Weighted Scores" must be multiplied by the Level 1 Weight to determine the Level 1 Weighted Score.*

HLW Salt Disposition Systems Engineering Team
Level 2 Evaluation Criteria Assessment Form

Alternative Number: 13 Alternative Title Small Tank TPB Precipitation

Date: 9/18/99

A. Evaluation Criterion Title: Qualify

Evaluation Criterion Description: Readily validate defined functional design requirements, regulatory requirements, final disposal forms, and Authorization Basis (AB) safety requirements.

B. Evaluation Criterion ID #: 5.2
(Note 1)

C. Evaluation Criterion Weighted Value: $\mathbf{W_2}$ = **.25**

D. Utility Functions:

	Utility Function (UF) Description:	UF Value (Note 2)
UF.1	Test program has known acceptance criteria and accommodates direct verification of design attributes.	100
UF.2	Test program applies "Graded Approach" to verify key design attributes with other limited testing and inferred results.	70
UF.3	Insufficient science/engineering exists to establish firm test acceptance criteria and methods, limited direct verification.	0

E. **UF VALUE:** $\mathbf{V_2}$ = **80**

Explanatory Notes for UF Selected: Majority of design attributes provide for direct verification. Process variables will require some inferred results.

F. Evaluation Criterion weighted score (WS) for the Alternative: $\mathbf{W_2 \times V_2 = WS \therefore .25 \times 80 = 20.00}$

Notes:

1. *For Level 1 Evaluation Criterion, the ID# is described by X.0, where X = 1, 2, 3,etc. For Level 2 Evaluation Criterion, the ID# is described by X.1, X.2, X.3, etc. where 'X' is the Level 1 Evaluation Criterion ID#.*
2. *Utility Function values range from 0 (least desirable) to 100 (most desirable).*
3. *If Level 2 Criterion are used, the sum of the Level 2 "Weighted Scores" must be multiplied by the Level 1 Weight to determine the Level 1 Weighted Score.*

HLW Salt Disposition Systems Engineering Team
Level 2 Evaluation Criteria Assessment Form

Alternative Number: 13 Alternative Title Small Tank TPB Precipitation

Date: 9/18/99

A. Evaluation Criterion Title: Operate

Evaluation Criterion Description: Maximize ease of repeat operation/proceduralization, access for round sheets/physical verification, and upset operation management (Section R-1.4-3 of Functions & Requirements).

B. Evaluation Criterion ID #: (Note 1) 5.3

C. Evaluation Criterion Weighted Value: $\mathbf{W_2}$ = **.25**

D. Utility Functions:

	Utility Function (UF) Description:	UF Value (Note 2)
UF.1	Design allows simple, coordinated, straight forward operation with direct access to key controls, interlocks, and instruments. Easy access to key equipment, maximize ALARA considerations. Minimize number of process control points.	100
UF.2	Design allows manageable operation with minimal complexity (Standard SRS practice).	60
UF.3	Design is highly coupled with minimum holdup, multiple parallel operations and fast dynamics, and process instability.	0

E. **UF VALUE:** $\mathbf{V_2}$ = **60**

Explanatory Notes for UF Selected: Single facility for salt solution processing comparable to standard SRS practices.

F. Evaluation Criterion weighted score (WS) for the Alternative: $\mathbf{W_2 \times V_2 = WS} \therefore$ **.25** × **60** = **15.00**

Notes:

1. *For Level 1 Evaluation Criterion, the ID# is described by X.0, where X = 1, 2, 3,etc. For Level 2 Evaluation Criterion, the ID# is described by X.1, X.2, X.3, etc. where 'X' is the Level 1 Evaluation Criterion ID#.*

2. *Utility Function values range from 0 (least desirable) to 100 (most desirable).*

3. *If Level 2 Criterion are used, the sum of the Level 2 "Weighted Scores" must be multiplied by the Level 1 Weight to determine the Level 1 Weighted Score.*

HLW Salt Disposition Systems Engineering Team
Level 2 Evaluation Criteria Assessment Form

Alternative Number: 13 Alternative Title: Small Tank TPB Precipitation

Date: 9/18/99

A. Evaluation Criterion Title: RAMI

Evaluation Criterion Description: Design to maximize Reliability, Availability, Maintainability, and Inspectability.

B. Evaluation Criterion ID #: (Note 1) 5.4

C. Evaluation Criterion Weighted Value: W_2 = **.25**

D. Utility Functions:

	Utility Function (UF) Description:	UF Value (Note 2)
UF.1	Design allows simple, coordinated, straight forward maintenance practices which take into account ALARA requirements. Design maximizes reliability, and availability of Structures, Systems, and Components.	100
UF.2	Design allows manageable maintenance functions with minimal complexibility (Standard SRS practice).	60
UF.3	Design complexity restricts maintainability and inspectability and reduces reliability, availability of Structures, Systems, and Components. Remoteability restricts maintainability.	0

E. **UF VALUE:** V_2 = **60**

Explanatory Notes for UF Selected: Single facility for salt solution processing comparable to standard SRS practice.

F. Evaluation Criterion weighted score (WS) for the Alternative: $W_2 \times V_2 = WS \therefore$ **.25** × **60** = **15.00**

Notes:

1. *For Level 1 Evaluation Criterion, the ID# is described by X.0, where X = 1, 2, 3,etc. For Level 2 Evaluation Criterion, the ID# is described by X.1, X.2, X.3, etc. where 'X' is the Level 1 Evaluation Criterion ID#.*

2. *Utility Function values range from 0 (least desirable) to 100 (most desirable).*

3. *If Level 2 Criterion are used, the sum of the Level 2 "Weighted Scores" must be multiplied by the Level 1 Weight to determine the Level 1 Weighted Score.*

HLW Salt Disposition Systems Engineering Team
Level 1 Evaluation Criteria Assessment Form

Alternative Number: 13 Alternative Title Small Tank TPB Precipitation

Date: 9/18/99

A. Evaluation Criterion Title: Cost/Schedule

Evaluation Criterion Description: Meet minimum combination of programmatic and technical risks and life cycle costs.

B. Evaluation Criterion ID #: 6.0
(Note 1)

C. Evaluation Criterion Weighted Value: $\mathbf{W_1}$ = **.12**

D. Utility Functions:

Utility Function (UF) Value (V_1) = Σ Level 2 Criterion Weighted Score (WS)

(Note 2)

E. UF Value Formula: $\mathbf{V_1 = WS_{6.1} + WS_{6.2} + WS_{6.3}}$
(Note 3)

F. Evaluation Criterion weighted score for the Alternative: $\mathbf{W_1 \times V_1}$ **= Weighted Score** ∴ **.12** × **78.00** = **9.36**

Explanatory Notes for Weighted Score:

Notes:

1. *For Level 1 Evaluation Criterion, the ID# is described by X.0, where X = 1, 2, 3,etc. For Level 2 Evaluation Criterion, the ID# is described by X.1, X.2, X.3, etc. where 'X' is the Level 1 Evaluation Criterion ID#.*

2. *Utility Function values range from 0 (least desirable) to 100 (most desirable).*

3. *If Level 2 Criterion are used, the sum of the Level 2 "Weighted Scores" must be multiplied by the Level 1 Weight to determine the Level 1 Weighted Score.*

HLW Salt Disposition Systems Engineering Team
Level 2 Evaluation Criteria Assessment Form

Alternative Number: 13 Alternative Title Small Tank TPB Precipitation

Date: 9/18/99

A. Evaluation Criterion Title: Regulatory Schedule Commitments

Evaluation Criterion Description: Maximize capability of disposing of radioactive wastes per Federal Facility Agreement (FFA) & Site Treatment Plan (STP) schedules or earlier.

B. Evaluation Criterion ID #: (Note 1) 6.1

C. Evaluation Criterion Weighted Value: W_2 = **.5**

D. Utility Functions:

Utility Function (UF) Description:		UF Value (Note 2)
UF.1	Accelerated Cleanup Plan (ACP) to empty High Level Waste (HLW) tanks by 2022 is met.	100
UF.2	Base Site Treatment Plan (STP) requirement to close HLW tanks by 2028 is met.	70
UF.3	Base STP or Federal Facility Agreement (FFA) requirements to close HLW tanks by committed dates is not met.	0

E. **UF VALUE:** V_2 = **80**

Explanatory Notes for UF Selected: DWPF operation supports STP requirements. Flexibility to expand throughput, but would not meet ACP.

F. Evaluation Criterion weighted score (WS) for the Alternative: $W_2 \times V_2 = WS \therefore$ **.5** × **80** = **40.00**

Notes:

1. *For Level 1 Evaluation Criterion, the ID# is described by X.0, where X = 1, 2, 3,etc. For Level 2 Evaluation Criterion, the ID# is described by X.1, X.2, X.3, etc. where 'X' is the Level 1 Evaluation Criterion ID#.*

2. *Utility Function values range from 0 (least desirable) to 100 (most desirable).*

3. *If Level 2 Criterion are used, the sum of the Level 2 "Weighted Scores" must be multiplied by the Level 1 Weight to determine the Level 1 Weighted Score.*

HLW Salt Disposition Systems Engineering Team
Level 2 Evaluation Criteria Assessment Form

Alternative Number: 13 Alternative Title Small Tank TPB Precipitation

Date: 9/18/99

A. Evaluation Criterion Title: Life Cycle Costs (LCC)

Evaluation Criterion Description: Minimize LCC including TEC, OPC, and D&D (excludes salvage and repository costs).

B. Evaluation Criterion ID #: (Note 1) 6.2

C. Evaluation Criterion Weighted Value: W_2 = .3

D. Utility Functions:

	Utility Function (UF) Description:	UF Value (Note 2)
UF.1	LCC ≤ 2 billion dollars.	100
UF.2	LCC is 4 billion dollars.	50
UF.3	LCC is 8 billion dollars.	25
UF.4	LCC ≥ 16 billion dollars.	0

E. **UF VALUE:** V_2 = **60**

Explanatory Notes for UF Selected: LCC equals 3.5 billion dollars. Based on past estimate. WSRC-RP-98-00167

F. Evaluation Criterion weighted score (WS) for the Alternative: $W_2 \times V_2 = WS \therefore$ **.3** × **60** = **18.00**

Notes:

1. *For Level 1 Evaluation Criterion, the ID# is described by X.0, where X = 1, 2, 3,etc. For Level 2 Evaluation Criterion, the ID# is described by X.1, X.2, X.3, etc. where 'X' is the Level 1 Evaluation Criterion ID#.*
2. *Utility Function values range from 0 (least desirable) to 100 (most desirable).*
3. *If Level 2 Criterion are used, the sum of the Level 2 "Weighted Scores" must be multiplied by the Level 1 Weight to determine the Level 1 Weighted Score.*

HLW Salt Disposition Systems Engineering Team
Level 2 Evaluation Criteria Assessment Form

Alternative Number: 13 Alternative Title Small Tank TPB Precipitation

Date: 9/18/99

A. Evaluation Criterion Title: Repository Costs

Evaluation Criterion Description: Minimize cost for waste disposal off-site (Federal Repository).

B. Evaluation Criterion ID #: 6.3
(Note 1)

C. Evaluation Criterion Weighted Value: $\mathbf{W_2}$ = **.2**

D. Utility Functions:

	Utility Function (UF) Description:	UF Value (Note 2)
UF.1	≤ 6000 canisters for off-site disposal	100
UF.2	68,000 canisters for off-site disposal.	50
UF.3	≥ 130,000 canisters for off-site disposal	0

E. **UF VALUE:** $\mathbf{V_2}$ = **100**

Explanatory Notes for UF Selected: DWPF canister production remains at 6000.

F. Evaluation Criterion weighted score (WS) for the Alternative: $\mathbf{W_2 \times V_2 = WS \therefore}$ **.2** × **100** = **20.00**

Notes:

1. *For Level 1 Evaluation Criterion, the ID# is described by X.0, where X = 1, 2, 3,etc. For Level 2 Evaluation Criterion, the ID# is described by X.1, X.2, X.3, etc. where 'X' is the Level 1 Evaluation Criterion ID#.*
2. *Utility Function values range from 0 (least desirable) to 100 (most desirable).*
3. *If Level 2 Criterion are used, the sum of the Level 2 "Weighted Scores" must be multiplied by the Level 1 Weight to determine the Level 1 Weighted Score.*

8.2 Cost Validation Matrix

8.2.1 Caustic Side Solvent Extraction

ID No.	**Caustic Side Solvent Extraction** Uncertainty Statement	Areas of Uncertainty									1	2	Explanatory Notes
		Mission	Technical Maturity	Environmental	Engineering / Design	Operation	Regulatory	Stakeholder	Safety	Radiological			
1	Decomposition/Degradation products may negatively affect downstream operations.		X								X		$1 million cost increase for 2 carbon bed filters. No change.
2	MST amount needed for decontamination exceeds DWPF Ti glass limits.						X					X	MST concentration of 0.4 g/L makes acceptable glass. WSRC-TR-99-00332
3	Crud formation in the system at the organic to aqueous interface.		X								X		$500,000 cost increase for crud separation tanks. No change.

ID No.	**Caustic Side Solvent Extraction** Uncertainty Statement	Areas of Uncertainty									1	2	Explanatory Notes
		Mission	Technical Maturity	Environmental	Engineering / Design	Operation	Regulatory	Stakeholder	Safety	Radiological			
4	Insufficient understanding of the operating window with respect to feed impurities. (DNFSB 96-1)		X								X		14 month delay in completing preliminary design. Some anionic impurities work was completed. HLW-SDT-99-0283 No change.
5	Difficulty in filtration of sludge and/or MST will produce low filtrate flow rates and require frequent cleaning				X						X		$6 million cost increase for the larger filters. $10 million cost increase for the larger pumps. Flux rate decrease from 0.07 to 0.02. WSRC-TR-99-00342

ID No.	**Caustic Side Solvent Extraction** Uncertainty Statement	Areas of Uncertainty: Mission	Technical Maturity	Environmental	Engineering / Design	Operation	Regulatory	Stakeholder	Safety	Radiological	1	2	Explanatory Notes
6	TRU decontamination with MST is not adequate with the design residence time.		X								X		125 Kgal. double lobe tank for dilution effect. MST concentration and residence time requires more research for bounding waste. No additional cost beyond Item 27.
7	Analysis delay (1 week) in measuring for Sr DF in MST process.		X								X		No cost or schedule impact, within existing R&D scope and schedule duration. No change.
8	What is the fate of Am in the process?		X									X	N/A No change.
9	Will not be able to procure sufficient extractant quantities.					X					X		No cost impact or schedule impact. No change.

ID No.	**Caustic Side Solvent Extraction** Uncertainty Statement	Areas of Uncertainty									1	2	Explanatory Notes
		Mission	Technical Maturity	Environmental	Engineering / Design	Operation	Regulatory	Stakeholder	Safety	Radiological			
10	Public acceptability may not be achieved.							X			X		$500,000 cost increase for public relations and analysis. No change.
11	DOE independent project review and acceptance may impact project milestones.						X				X		Schedule impact of 1 month at end of conceptual design, 1 month at the end of preliminary design, 2 month at the end of final design and 1 month prior to radioactive operations. No change.

ID No.	**Caustic Side Solvent Extraction** Uncertainty Statement	Areas of Uncertainty									1	2	Explanatory Notes
		Mission	Technical Maturity	Environmental	Engineering / Design	Operation	Regulatory	Stakeholder	Safety	Radiological			
12	Change in requirements and standards, such as NRC licensing may impact the cost and schedule.						X					X	18 month delay to radioactive operations. Additional $1 million cost. SAR may cause 4 month delay in completing preliminary design. NRC standards equivalency will be part of design process. HLW-SDT-99-0062 No change.
13	DOE lack of support of required budget and schedule may delay new facility startup.							X			X		6 month schedule impact in the first year. 7 month schedule impact in the second year. 7 month schedule impact in the third year. No change.

ID No.	**Caustic Side Solvent Extraction** Uncertainty Statement	Areas of Uncertainty									1	2	Explanatory Notes
		Mission	Technical Maturity	Environmental	Engineering / Design	Operation	Regulatory	Stakeholder	Safety	Radiological			
14	SRS infrastructure may not support the project needs.					X					X		$31 million cost increase for overtime resulting from staffing delays. No change.
15	Waste removal is being accelerated. May conflict with preferred alternatives or preferred alternative may divert resources from waste removal project.	X									X		No additional cost or schedule impact beyond item 13. No change.

ID No.	**Caustic Side Solvent Extraction** Uncertainty Statement	Areas of Uncertainty									1	2	Explanatory Notes
		Mission	Technical Maturity	Environmental	Engineering / Design	Operation	Regulatory	Stakeholder	Safety	Radiological			
16	Pressure on 'old' infrastructure will increase, endangering schedule due to three fold increase in flow requirements from HTF and FTF. This would endanger performance of infrastructure.					X					X		9 month delay in completing salt removal from a production schedule delay to reach salt solution feed rate assumption. Basis: 50% material movement in the first year results in 6 months and 75% material movement in the second year results in 3 months. No change.
17	Improper contract strategy for design work may impact the schedule.				X						X		6 month delay in completing conceptual design. No change.
18	Research and development work performed must be coordinated with the design effort.		X								X		3 month delay in completing preliminary design. No change.

ID No.	**Caustic Side Solvent Extraction** Uncertainty Statement	Areas of Uncertainty									1	2	Explanatory Notes
		Mission	Technical Maturity	Environmental	Engineering / Design	Operation	Regulatory	Stakeholder	Safety	Radiological			
19	Geotechnical problems with siting locations may cause schedule delays.				X							X	Site selection and geotechnical characterization was completed with no subsurface concerns. WSRC-RP-99-00513
20	A clearly defined safety strategy should be agreed to by the end of conceptual design to preclude schedule impacts.								X		X		2 month delay in start of preliminary design. No change.
21	High source term with credible release mechanisms will concern public.							X			X		Within the existing estimate. No change.

ID No.	**Caustic Side Solvent Extraction** Uncertainty Statement	Areas of Uncertainty									1	2	Explanatory Notes
		Mission	Technical Maturity	Environmental	Engineering / Design	Operation	Regulatory	Stakeholder	Safety	Radiological			
22	Solvent estimated unit cost rate may be reduced.					X					X		Solvent extractant cost bases decreases from $500 to $175 per gram, resulting in a $190 million life cycle cost decrease. No change.
23	Solvent estimated consumption cost may be reduced.					X					X		Change cost bases to complete replacement of solvent every 2 years and solvent extractant cost bases to $175 per gram resulting in a $51 million cost decrease. No change.
24	The interfacing facilities operational schedules may impact completion of tie-ins to the new facility.					X					X		2 month production delay for DWPF to install new transfer line. No change.

ID No.	**Caustic Side Solvent Extraction** Uncertainty Statement	Areas of Uncertainty									1	2	Explanatory Notes
		Mission	Technical Maturity	Environmental	Engineering / Design	Operation	Regulatory	Stakeholder	Safety	Radiological			
25	GT-73 unit operations may not be required.				X						X		$25 million cost decrease. No change. WSRC-RP-99-00006
26	Improved stripping capabilities may reduce the number of overall stages by 12 to 16.				X						X		$25 million cost decrease. The addition of TOA has reduced the stripping coefficient distribution. HLW-SDT-99-0283
27	Difficulty in resuspending MST after long quiescent period will require temperature control and mixing equipment.				X						X		$10 million cost increase (based on the cost estimate for a 100 Kgal. Alpha adsorption tank). ORNL/TM-1999/166

8.2.2 CST Non-Elutable Ion Exchange

ID No.	**CST Non-Elutable Ion Exchange** Uncertainty Statement	Areas of Uncertainty									1	2	Explanatory Notes
		Mission	Technical Maturity	Environmental	Engineering / Design	Operation	Regulatory	Stakeholder	Safety	Radiological			
1	What is the fate of Am in the process?		X									X	N/A No change.
2	Inability to remove spent resin from a column.				X							X	Resin transport has been demonstrated. No change. ORNL-TM-1999/103
3	Method of flow control between columns (pumping/gravity)				X							X	Demonstrated down-flow configuration with gas disengagement from the bottom of the column. No change. ORNL-TM-1999/103

ID No.	**CST Non-Elutable Ion Exchange** Uncertainty Statement	Areas of Uncertainty									1	2	Explanatory Notes
		Mission	Technical Maturity	Environmental	Engineering / Design	Operation	Regulatory	Stakeholder	Safety	Radiological			
4	Resin bed temperature control during operational conditions and loaded spent resin temperature control.				X						X		$10 million cost increase for safety class emergency cooling and temperature monitoring. R&D results indicate a need for cooling to support normal and emergency operations. No change. ORNL-TM-1999/233
5	Analysis delay (1 week) in measuring for Sr DF in MST process.		X								X		No cost or schedule impact, within existing R&D scope and schedule duration. No change.

ID No.	**CST Non-Elutable Ion Exchange** Uncertainty Statement	Areas of Uncertainty									1	2	Explanatory Notes
		Mission	Technical Maturity	Environmental	Engineering / Design	Operation	Regulatory	Stakeholder	Safety	Radiological			
6	Can pressure gradients crush the resin during column operations?				X						X		$2.5 million cost increase for 4 additional columns. $2.5 million cost increase for associated jumpers. $2.6 million cost increase for 2 additional personnel during the operational life of the facility. No change.
7	Application of carousel design in a remote environment (e.g. operation and maintenance).				X							X	Design incorporates jumpers and not valves. No change.
8	Is the shielding in the current transfer lines adequate for transferring spent/ loaded resin?									X		X	N/A No change.

ID No.	**CST Non-Elutable Ion Exchange** Uncertainty Statement	Areas of Uncertainty									1	2	Explanatory Notes
		Mission	Technical Maturity	Environmental	Engineering / Design	Operation	Regulatory	Stakeholder	Safety	Radiological			
9	Difficulty in filtration of sludge and/or MST will produce low filtrate flow rates and require frequent cleaning				X						X		$6 million cost increase for the larger filters. $10 million cost increase for the larger pumps. Flux rate decrease from 0.07 to 0.02. WSRC-TR-99-0342
10	TRU decontamination with MST is not adequate with the design residence time.		X								X		125 Kgal double lobe tank for dilution effect. MST concentration and residence time requires more research for bounding waste. No additional cost beyond Item 34.

ID No.	**CST Non-Elutable Ion Exchange** Uncertainty Statement	Areas of Uncertainty									1	2	Explanatory Notes
		Mission	Technical Maturity	Environmental	Engineering / Design	Operation	Regulatory	Stakeholder	Safety	Radiological			
11	Process chemistry understanding and application are still under development, resulting in 96-1 lessons learned not yet implemented		X								X		9 month delay in completing conceptual design and a 9 month delay in completing preliminary design. $10 million cost increase to support product development. Product is considered to be still under development and by experiment, has exhibited stability and leaching problems. A 1 to 2 year development duration has been suggested by the developer and the vendor. ORNL/TM-1999/233

ID No.	**CST Non-Elutable Ion Exchange** Uncertainty Statement	Areas of Uncertainty									1	2	Explanatory Notes
		Mission	Technical Maturity	Environmental	Engineering / Design	Operation	Regulatory	Stakeholder	Safety	Radiological			
12	CST will require "requalification" of glass form.						X				X		\$15 million cost increase to support glass requalification (durability and TiO_2). R&D has indicated glass requalification and hydraguard sampling modification is required. WSRC-RP-99-00195 WSRC-TR-99-00245

ID No.	**CST Non-Elutable Ion Exchange** Uncertainty Statement	Areas of Uncertainty									1	2	Explanatory Notes
		Mission	Technical Maturity	Environmental	Engineering / Design	Operation	Regulatory	Stakeholder	Safety	Radiological			
13	The CST material may not be available in sufficient quantities to support the process (50 tons per year).					X					X		No schedule impact and within the cost estimate. Scale up attempts (2) have resulted in issues to be resolved. No change. WSRC-RP-99-00568
14	Major sample station modification affecting DWPF operations.									X	X		$5 million cost increase for sample cell modifications for shielding. No change.
15	CST resin fines may collect in downstream filters, elbows, imperfect welds, and instrument lines.									X	X		$2 million cost increase for related modifications (e.g., shielding). No change.

ID No.	**CST Non-Elutable Ion Exchange** Uncertainty Statement	Areas of Uncertainty									1	2	Explanatory Notes
		Mission	Technical Maturity	Environmental	Engineering / Design	Operation	Regulatory	Stakeholder	Safety	Radiological			
16	DOE independent project review and acceptance may impact project milestones.						X				X		Schedule impact of 1 month at end of conceptual design, 1 month at the end of preliminary design, 2 months at the end of final design and 1 month prior to radioactive operations. No change.

ID No.	**CST Non-Elutable Ion Exchange** Uncertainty Statement	Areas of Uncertainty: Mission	Technical Maturity	Environmental	Engineering / Design	Operation	Regulatory	Stakeholder	Safety	Radiological	1	2	Explanatory Notes
17	Change in requirements and standards, such as NRC licensing may impact the cost and schedule.						X				X		18 month delay to radioactive operations. Additional $1 million cost. SAR may cause 4 month delay in completing preliminary design. NRC standards equivalency will be part of the design process. HLW-SDT-99-0062 No change.
18	The interfacing facilities operational schedules may impact completion of tie-ins to the new facility.					X					X		2 month production delay for DWPF to install new transfer line. No change.

ID No.	**CST Non-Elutable Ion Exchange** Uncertainty Statement	Areas of Uncertainty									1	2	Explanatory Notes
		Mission	Technical Maturity	Environmental	Engineering / Design	Operation	Regulatory	Stakeholder	Safety	Radiological			
19	DOE lack of support of required budget and schedule may delay new facility startup.							X			X		5 month schedule impact in the first year. 5 month schedule impact in the second year. 4 month schedule impact in the third year. No change.
20	SRS infrastructure may not support the project needs.					X					X		$26.5 million cost increase for overtime resulting from staffing delays. No change.

ID No.	**CST Non-Elutable Ion Exchange** Uncertainty Statement	Areas of Uncertainty									1	2	Explanatory Notes
		Mission	Technical Maturity	Environmental	Engineering / Design	Operation	Regulatory	Stakeholder	Safety	Radiological			
21	Waste removal is being accelerated. May conflict with preferred alternatives or preferred alternative may divert resources from waste removal project.	X									X		No additional cost and schedule impact beyond Item 19. No change.
22	Pressure on 'old' infrastructure will increase, endangering schedule due to three fold increase in flow requirements from HTF and FTF. This would endanger performance of infrastructure.					X					X		9 month delay in completing salt removal from a production schedule delay to reach salt solution feed rate assumption. Basis: 50% material movement in the first year results in 6 months and 75% material movement in the second year results in 3 months. No change.

ID No.	**CST Non-Elutable Ion Exchange** Uncertainty Statement	Areas of Uncertainty									1	2	Explanatory Notes
		Mission	Technical Maturity	Environmental	Engineering / Design	Operation	Regulatory	Stakeholder	Safety	Radiological			
23	Improper contract strategy for design work may impact the schedule.				X						X		6 month delay in completing conceptual design. No change.
24	Research and development work performed must be coordinated with the design effort.		X								X		6 month delay in completing preliminary design. No change.
25	Geotechnical problems with siting locations may cause schedule delays.				X							X	Site selection and geotechnical characterization was completed with no subsurface concerns. WSRC-RP-99-00513
26	A clearly defined safety strategy should be agreed to by the end of conceptual design to preclude schedule impacts.								X		X		2 month delay in the start of preliminary design. No change.

ID No.	**CST Non-Elutable Ion Exchange** Uncertainty Statement	Areas of Uncertainty: Mission	Technical Maturity	Environmental	Engineering / Design	Operation	Regulatory	Stakeholder	Safety	Radiological	1	2	Explanatory Notes
27	High source term with credible release mechanisms will concern public.								X		X		Within the existing estimate. No change.
28	Increased foaming in the DWPF Chemical Process Cell.		X									X	Foaming during 1/240th scale testing was acceptable and no scale up issues expected. WSRC-TR-99-00302
29	Cesium desorption at elevated resin temperature.		X								X		No additional cost impact beyond Item 4. Cesium desorps at elevated temperature. ORNL/TM-1999/233 No change.
30	GT-73 unit operation may not be required.				X						X		$27 million cost decrease. No change. WSRC-RP-99-00006

ID No.	**CST Non-Elutable Ion Exchange** Uncertainty Statement	Areas of Uncertainty									1	2	Explanatory Notes
		Mission	Technical Maturity	Environmental	Engineering / Design	Operation	Regulatory	Stakeholder	Safety	Radiological			
31	Resin stability at elevated temperature.		X								X		No additional cost impact beyond Item 11. No change.
32	Impact of CST on DWPF redox.		X								X		No additional schedule impact beyond Item 24. No change.
33	Hydrogen and oxygen generation in the loaded column.				X						X		Tankage for hydrogen gas collection and associated safety equipment. $30 million cost increase. Gas generation was demonstrated to require gas disengagement equipment at the outlet of the column. No change.

ID No.	**CST Non-Elutable Ion Exchange** Uncertainty Statement	Areas of Uncertainty									1	2	Explanatory Notes
		Mission	Technical Maturity	Environmental	Engineering / Design	Operation	Regulatory	Stakeholder	Safety	Radiological			
34	Difficulty in resuspending MST after long quiescent period will require temperature control and mixing equipment.				X						X		$10 million cost increase (based on the cost estimate for a 100 Kgal. Alpha adsorption tank). ORNL/TM-1999/166
35	Aluminum precipitation in the resin column impacts production.				X						X		$64 million on cost increase for caustic dilution of feed and additional saltstone production (820 Kgal./yr. saltstone at $4/gal. and 125 Kgal/yr. 50%wt caustic at $4.25/gal and two vaults at $9 million per vault. HLW-SDT-99-0303

8.2.3 Direct Disposal in Grout

ID No.	**Direct Disposal in Grout** Uncertainty Statement	Areas of Uncertainty: Mission	Technical Maturity	Environmental	Engineering / Design	Operation	Regulatory	Stakeholder	Safety	Radiological	1	2	Explanatory Notes
1	Existing vault design may have to be upgraded with liners, ventilation upgrades, temperature monitoring, leachate collection, capping/backfilling, elimination of floor penetrations, HEPA filtration of moist atmosphere and the addition of cell access for failed equipment disposal.				X						X		$5 million cost increase for long term hydrogen collection system. No Change.

ID No.	**Direct Disposal in Grout** Uncertainty Statement	Areas of Uncertainty											
		Mission	Technical Maturity	Environmental	Engineering / Design	Operation	Regulatory	Stakeholder	Safety	Radiological	1	2	Explanatory Notes
2	Developing a formulation capable of maintaining structural and chemical integrity after extended curing of grout at up to 90 ^{o}C may not be possible.		X								X		No cost or schedule impact. No change.
3	Long half life isotopes may impact the Performance Assessment (PA).						X				X		No cost or schedule impact. No change. WSRC-TR-99-00227

ID No.	**Direct Disposal in Grout** Uncertainty Statement	Areas of Uncertainty									1	2	Explanatory Notes
		Mission	Technical Maturity	Environmental	Engineering / Design	Operation	Regulatory	Stakeholder	Safety	Radiological			
4	Difficulty in filtration of sludge and/or MST will produce low filtrate flow rates and require frequent cleaning				X						X		$6 million cost increase for the larger filters. $10 million cost increase for the larger pumps. Flux rate decrease from 0.07 to 0.02. WSRC-TR-99-00342
5	TRU decontamination with MST is not adequate with the design residence time.		X								X		125 Kgal. double lobe tank for dilution effect. MST concentration and residence time requires more research for bounding waste. No additional cost beyond Item 28.
6	MST amount needed for decontamination exceeds DWPF Ti glass limits.						X					X	MST concentration of 0.4 g/L makes acceptable glass. WSRC-TR-99-00332

ID No.	**Direct Disposal in Grout** Uncertainty Statement	Areas of Uncertainty									1	2	Explanatory Notes
		Mission	Technical Maturity	Environmental	Engineering / Design	Operation	Regulatory	Stakeholder	Safety	Radiological			
7	Analysis delay (1 week) in measuring for Sr DF in MST process.		X								X		No cost or schedule impact, within existing R&D scope and schedule duration. No change.
8	What is the fate of Am in the process?		X									X	N/A No change.
9	Process not acceptable to general public.							X			X		24 month delay in start of final design. Can start at end of conceptual design based on NEPA documentation. No change. October 1998 Stakeholder Focus Group of CAB.
10	Potential for extended delay from NEPA/EIS process.						X				X		No impact beyond Item 9. No change.

ID No.	**Direct Disposal in Grout** Uncertainty Statement	Areas of Uncertainty									1	2	Explanatory Notes
		Mission	Technical Maturity	Environmental	Engineering / Design	Operation	Regulatory	Stakeholder	Safety	Radiological			
11	Technical regulatory agencies may delay approvals.						X				X		5 year delay to complete construction for high level waste in SC. 2 year delay in radioactive operation for redesign and EIS. No change.
12	Political representatives of public may delay approvals.							X			X		No additional cost or schedule impact beyond Item 11. No change.
13	Process not technically supportive of future missions (e.g. can-in-can)	X									X		$50 million cost increase to support commitment to can-in-can mission. No change.

ID No.	**Direct Disposal in Grout** Uncertainty Statement	Areas of Uncertainty									1	2	Explanatory Notes
		Mission	Technical Maturity	Environmental	Engineering / Design	Operation	Regulatory	Stakeholder	Safety	Radiological			
14	DOE independent project review and acceptance may impact project milestones.						X				X		Schedule impact of 1 month at end of conceptual design, 1 month at the end of preliminary design, 2 months at the end of final design and 12 months prior to radioactive operations. No change.
15	Change in requirements and standards, such as NRC licensing may impact the cost and schedule.						X				X		No additional cost or schedule impact beyond Item 11. NRC standards equivalency will be part of the design process. No change. HLW-SDT-99-0062

ID No.	**Direct Disposal in Grout** Uncertainty Statement	Areas of Uncertainty									1	2	Explanatory Notes
		Mission	Technical Maturity	Environmental	Engineering / Design	Operation	Regulatory	Stakeholder	Safety	Radiological			
16	The interfacing facilities operational schedules may impact completion of tie-ins to the new facility.					X					X		No additional cost or schedule impact based on opportunity to coordinate with DWPF outages. No change.
17	DOE lack of support of required budget and schedule may delay new facility startup.							X			X		3 month schedule impact in the first year. 5 month schedule impact in the second year. No change.
18	SRS infrastructure may not support the project needs.					X					X		$20 million cost increase for overtime resulting from staffing delays. No change.

ID No.	**Direct Disposal in Grout** Uncertainty Statement	Areas of Uncertainty									1	2	Explanatory Notes
		Mission	Technical Maturity	Environmental	Engineering / Design	Operation	Regulatory	Stakeholder	Safety	Radiological			
19	Waste removal is being accelerated. May conflict with preferred alternative or preferred alternative may divert resources from waste removal project.	X									X		No additional cost or schedule impact beyond Item 17. No change.

ID No.	**Direct Disposal in Grout** Uncertainty Statement	Areas of Uncertainty									1	2	Explanatory Notes
		Mission	Technical Maturity	Environmental	Engineering / Design	Operation	Regulatory	Stakeholder	Safety	Radiological			
20	Pressure on 'old' infrastructure will increase, endangering schedule due to three fold increase in flow requirements from HTF and FTF. This would endanger performance of infrastructure.					X					X		9 month delay in completing salt removal from a production schedule delay to reach salt solution feed rate assumption. Basis: 50% material movement in the first year results in 6 months and 75% material movement in the second year results in 3 months. No change.
21	A clearly defined safety strategy should be agreed to by the end of conceptual design to preclude schedule impacts.								X		X		No additional cost or schedule impact beyond Item 11. No change.

ID No.	**Direct Disposal in Grout** Uncertainty Statement	Areas of Uncertainty									1	2	Explanatory Notes
		Mission	Technical Maturity	Environmental	Engineering / Design	Operation	Regulatory	Stakeholder	Safety	Radiological			
22	Improper contract strategy for design work may impact the schedule.				X						X		6 month delay in completing conceptual design. No change.
23	Dry material handling may be a problem.				X							X	N/A No change.
24	Geotechnical problems with siting locations may cause schedule delays.				X						X		12 month delay in start of final design. $105 million cost increase (based on 10% of TEC + $34 million for substructure grout + contingency percentage). No change.
25	GT-73 unit operations may not be required.				X						X		$27 million cost decrease. No change. WSRC-RP-99-00006

ID No.	**Direct Disposal in Grout** Uncertainty Statement	Areas of Uncertainty: Mission	Technical Maturity	Environmental	Engineering / Design	Operation	Regulatory	Stakeholder	Safety	Radiological	1	2	Explanatory Notes
26	DWPF recycle stream does not contain cesium concentration assumed in HLW System Plan.					X					X		$65 million cost decrease. Basis is DWPF recycle rerouted to ETF saving evaporator operation. No change.
27	Suspect product may not be able to be recovered.					X					X		$9 million cost increase based on abandoning a vault. No change.
28	Difficulty in resuspending MST after long quiescent period will require temperature control and mixing equipment.				X						x		$10 million cost increase (based on the cost estimate for a 100 Kgal. Alpha adsorption tank). ORNL/TM-1999/166

8.2.4 Small Tank TPB Precipitation

ID No.	**Small Tank TPB Precipitation** Uncertainty Statement	Areas of Uncertainty									1	2	Explanatory Notes
		Mission	Technical Maturity	Environmental	Engineering / Design	Operation	Regulatory	Stakeholder	Safety	Radiological			
1	Close coupled unit operations adds production complexity. Salt Cell in DWPF has to be operated in this option.					X					X		$80 million increase to relocate precipitate hydrolysis process from DWPF to the new Salt Disposition Facility and increase equipment sizing to achieve tank farm waste handling limitation. 28 months operating time reduction due to increased process rate. HLW-SDT-99-0266 WSRC-RP-99-00006 WSRC-RP-99-00005

ID No.	**Small Tank TPB Precipitation** Uncertainty Statement	Areas of Uncertainty									1	2	Explanatory Notes
		Mission	Technical Maturity	Environmental	Engineering / Design	Operation	Regulatory	Stakeholder	Safety	Radiological			
2	Benzene releases may exceed permit levels due to additional (unknown) catalytic effects or catalyst build-up through plate-out.		X								X		Benzene emission reduction system estimated at $5 million to meet permit limits. No change.
3	Limited experience with the hydrolysis of fresh precipitate in the Salt Process Cell.		X									X	N/A No change. WSRC-TR-99-00272
4	Process will not produce the DF required because of slow kinetics of MST and TPB.				X							X	R&D results indicate the design basis is acceptable. WSRC-TR-99-00345 ORNL/TM-1999/234

ID No.	**Small Tank TPB Precipitation** Uncertainty Statement	Areas of Uncertainty									1	2	Explanatory Notes
		Mission	Technical Maturity	Environmental	Engineering / Design	Operation	Regulatory	Stakeholder	Safety	Radiological			
5	Process chemistry understanding and application are being verified. (96-1 Lessons Learned)		X								X		4 month schedule delay in completing preliminary design to resolve foaming issues in the process vessels.Catalyst activation greater than the bounding case results in a loss of product DF requiring operational delays for resolution. 6 month delay in completing operation due to loss of one macro batch every 4 years and 2 months to recover a macro batch. WSRC-TR-99-00279 WSRC-TR-99-00345

ID No.	**Small Tank TPB Precipitation** Uncertainty Statement	Areas of Uncertainty									1	2	Explanatory Notes
		Mission	Technical Maturity	Environmental	Engineering / Design	Operation	Regulatory	Stakeholder	Safety	Radiological			
6	MST amount needed for decontamination exceeds DWPF Ti glass limits.						X					X	MST concentration of 0.4 g/L makes acceptable glass. WSRC-TR-99-00332
7	Analysis delay (1 week) in measuring for Sr DF in MST process.		X								X		No cost or schedule impact, within existing R&D scope and schedule duration. No change.
8	What is the fate of Am in the process?		X									X	N/A No change. October 1998 Stakeholder Focus Group of CAB.
9	Stakeholders will reject the alternative. Similar to large tank.							X			X		Covered within the existing cost and schedule estimate. No change. October 1998 Stakeholder Focus Group of CAB.

ID No.	**Small Tank TPB Precipitation** Uncertainty Statement	Areas of Uncertainty									1	2	Explanatory Notes
		Mission	Technical Maturity	Environmental	Engineering / Design	Operation	Regulatory	Stakeholder	Safety	Radiological			
10	Geotechnical problems with siting locations may cause schedule delays.				X							X	Site selection and geotechnical characterization was completed with no subsurface concerns. WSRC-RP-99-00513
11	Organics fed to tank farms.	X										X	N/A No change.

ID No.	**Small Tank TPB Precipitation** Uncertainty Statement	Areas of Uncertainty									1	2	Explanatory Notes
		Mission	Technical Maturity	Environmental	Engineering / Design	Operation	Regulatory	Stakeholder	Safety	Radiological			
12	DOE independent project review and acceptance may impact project milestones.						X				X		Schedule impact of 3 month to start conceptual design for addressing GAO issues, 1 month at end of conceptual design, 1 month at the end of preliminary design, 2 months at the end of final design and 1 month prior to radioactive operations. GAO/RECD-99-69

ID No.	**Small Tank TPB Precipitation** Uncertainty Statement	Areas of Uncertainty									1	2	Explanatory Notes
		Mission	Technical Maturity	Environmental	Engineering / Design	Operation	Regulatory	Stakeholder	Safety	Radiological			
13	Change in requirements and standards, such as NRC licensing may impact the cost and schedule.						X				X		18 month delay to radioactive operations. Additional $1 million cost. SAR may cause 4 month delay in completing preliminary design. NRC standards equivalency will be part of design process. HLW-SDT-99-0062 No change.
14	The interfacing facilities operational schedules may impact completion of tie-ins to the new facility.					X					X		2 month production delay for DWPF to install new transfer line. Based on number 1.

ID No.	**Small Tank TPB Precipitation** Uncertainty Statement	Areas of Uncertainty									1	2	Explanatory Notes
		Mission	Technical Maturity	Environmental	Engineering / Design	Operation	Regulatory	Stakeholder	Safety	Radiological			
15	DOE lack of support of required budget and schedule may delay new facility startup.							X			X		5 month schedule impact in the first year. 6 month schedule impact in the second year. 5 month schedule impact in the third year. No change.
16	SRS infrastructure may not support the project needs.					X					X		$22 million cost increase for overtime resulting from staffing delays. No change.

ID No.	**Small Tank TPB Precipitation** Uncertainty Statement	Areas of Uncertainty									1	2	Explanatory Notes
		Mission	Technical Maturity	Environmental	Engineering / Design	Operation	Regulatory	Stakeholder	Safety	Radiological			
17	Waste removal is being accelerated. May conflict with preferred alternatives or preferred alternative may divert resources from waste removal project.	X									X		No additional cost or schedule impact beyond item 15. No change.

ID No.	**Small Tank TPB Precipitation** Uncertainty Statement	Areas of Uncertainty									1	2	Explanatory Notes
		Mission	Technical Maturity	Environmental	Engineering / Design	Operation	Regulatory	Stakeholder	Safety	Radiological			
18	Pressure on 'old' infrastructure will increase, endangering schedule due to three fold increase in flow requirements from HTF and FTF. This would endanger performance of infrastructure.					X					X		9 month delay in completing salt removal from a production schedule delay to reach salt solution feed rate assumption. Basis: 50% material movement in the first year results in 6 months and 75% material movement in the second year results in 3 months. No change.
19	Improper contract strategy for design work may impact the schedule.				X						X		6 month delay in completing conceptual design. No change.

ID No.	**Small Tank TPB Precipitation** Uncertainty Statement	Areas of Uncertainty									1	2	Explanatory Notes
		Mission	Technical Maturity	Environmental	Engineering / Design	Operation	Regulatory	Stakeholder	Safety	Radiological			
20	Research and development work performed must be coordinated with the design effort.				X						X		6 month delay in completing preliminary design. No change.
21	A clearly defined safety strategy should be agreed to by the end of conceptual design to preclude schedule impacts.								X		X		2 month delay in start of preliminary design. No change.
22	High source term with credible release mechanisms will concern public.								X		X		Within the existing estimate. No change.
23	Inefficiency in the wash cycle results in an increase in NaTPB consumption.				X						X		$25 million cost increase. ORNL/TM-1999/234

ID No.	**Small Tank TPB Precipitation** Uncertainty Statement	Areas of Uncertainty									1	2	Explanatory Notes
		Mission	Technical Maturity	Environmental	Engineering / Design	Operation	Regulatory	Stakeholder	Safety	Radiological			
24	Ability to recycle wash water reduces the volume of saltstone produced.					X					X		7.8 million gallons of saltstone reduction at $4 per gallon results in a cost savings of $30 million and saving the cost of one vault of $9 million. WSRC-RP-99-00006

8.3 Risk Categorization Matrix

8.3.1 Caustic Side Solvent Extraction

ID No.	**Caustic Side Solvent Extraction** Uncertainty Statement	Areas of Uncertainty									1	2	Explanatory Notes
		Mission	Technical Maturity	Environmental	Engineering / Design	Operation	Regulatory	Stakeholder	Safety	Radiological			
1	Decomposition/Degradation products may negatively affect saltstone grout quality and/or GT-73 performance. (Soluble in Raffinate)				X						X		Selected unit operations for organic removal dependent upon unknown impurities in raffinate. No change.
2	Proposed methods of solvent clean up do not remove deleterious degradation products. (applies to all 3 solvent components).		X								X		Range of degradation products undefined. Solution may be a balance of treatment and purge rates. No change.

ID No.	**Caustic Side Solvent Extraction** Uncertainty Statement	Areas of Uncertainty									1	2	Explanatory Notes
		Mission	Technical Maturity	Environmental	Engineering / Design	Operation	Regulatory	Stakeholder	Safety	Radiological			
3	MST amount needed for decontamination exceeds DWPF Ti glass limits.											X	MST concentration of 0.4 g/L makes acceptable glass. WSRC-TR-99-00332
4	Solids formation in contactors.											X	Design to allow for ease of contactor draining and flushing. No change.
5	CRUD formation in the system at the organic to aqueous interface.		x								X		CRUD formation impacts stage efficiency resulting in increased number of stages or flowsheet changes. No change.
6	The corrosion effects of fluoride from degradation of the aromatic modifier.											X	

ID No.	**Caustic Side Solvent Extraction** Uncertainty Statement	Areas of Uncertainty									1	2	Explanatory Notes
		Mission	Technical Maturity	Environmental	Engineering / Design	Operation	Regulatory	Stakeholder	Safety	Radiological			
7	Flowsheet modifications to improve stripping efficiency (temperature increase or nitrate addition) have not demonstrated the required DF.		x								X		Continuous radioactive operation has not been demonstrated. HLW-SDT-99-0283
8	Actinides may concentrate within the system (solvent).												File No Change.
9	Cobalt source gives inadequate simulation for radiolysis of solvent by Cs 137.												File No change.
10	Purity of solvent may not meet requirements.											X	No change.

ID No.	**Caustic Side Solvent Extraction** Uncertainty Statement	Areas of Uncertainty									1	2	Explanatory Notes
		Mission	Technical Maturity	Environmental	Engineering / Design	Operation	Regulatory	Stakeholder	Safety	Radiological			
11	Modifier in solvent will not be commercially available.												File No change.
12	Existing transfer lines and tank size and drain back not adequate, and leads to inefficiencies.											X	No change.
13	Flexibility of output stream in coupling to DWPF.												File Purer feed stream does not effect Tank Farm feed preparation rate. No change.
14	Centrifuge contactor reaches steady state very quickly (minutes-hours). Easy to shut down on weekends and restart.												File No change.

ID No.	**Caustic Side Solvent Extraction** Uncertainty Statement	Areas of Uncertainty									1	2	Explanatory Notes
		Mission	Technical Maturity	Environmental	Engineering / Design	Operation	Regulatory	Stakeholder	Safety	Radiological			
15	Frequent sampling and flow monitoring to check for operation of the contactor banks.											X	No change.
16	There is no analytical method for the 3 compound solvent system.											X	No change.
17	Insufficient understanding of the operating window with respect to solvent components and impurities.					x					X		Operating window for process needs to be defined. R&D work required. Some anionic impurities work was completed. No change. HLW-SDT-99-0283 File
18	Process is tolerant of feed variations (Cs^+, Na^+, K^+ concentrations.)												No change.

ID No.	**Caustic Side Solvent Extraction** Uncertainty Statement	Areas of Uncertainty									1	2	Explanatory Notes
		Mission	Technical Maturity	Environmental	Engineering / Design	Operation	Regulatory	Stakeholder	Safety	Radiological			
19	Favorable impacts on DWPF AB.												File No change.
20	High reliability of canyon centrifugal six-pack. Only 1 change in >30 years.												File No change.
21	Recovery from process upsets (Phase inversions, failures,...)											X	No change.
22	Solids on filters will not dissolve or would be difficult to dissolve in oxalic acid.												File No change.

ID No.	**Caustic Side Solvent Extraction** Uncertainty Statement	Areas of Uncertainty									1	2	Explanatory Notes
		Mission	Technical Maturity	Environmental	Engineering / Design	Operation	Regulatory	Stakeholder	Safety	Radiological			
23	Accumulation of hydrogen may occur in vapor spaces (including process vessels) and deflagrations/detonation could occur if there is a spark source.											X	No change.
24	Flammability of organic solvent throughout process and sumps.											X	No change.
25	Does cold Cs^+ take up active sites and influence solvent efficiency or recycle.		x								X		Cold cesium not expected to be used in the solvent system. HLW-SDT-99-0283
26	Potential for solvent nitration (by radiolysis).											X	No change.
27	Reactions in solvent recovery still.												File No change.

ID No.	**Caustic Side Solvent Extraction** Uncertainty Statement	Areas of Uncertainty									1	2	Explanatory Notes
		Mission	Technical Maturity	Environmental	Engineering / Design	Operation	Regulatory	Stakeholder	Safety	Radiological			
28	Choice of equipment for solvent washing, organic removal and treatment needs to be considered.											X	No change.
29	Need a cold waste stream to start up contactors so as not to contaminate clean equipment. (May be able to use clean raffinate).											X	No change.
30	Fate of mercury in the process and potential accumulation mechanisms. Results in material and process impacts.		x								X		Mercury removal step may be required to be moved upstream. No change.
31	Mechanical energy of contactors provides an energy source for dispersal.											X	No change.

ID No.	**Caustic Side Solvent Extraction** Uncertainty Statement	Areas of Uncertainty									1	2	Explanatory Notes
		Mission	Technical Maturity	Environmental	Engineering / Design	Operation	Regulatory	Stakeholder	Safety	Radiological			
32	Require adequate size of remote and contact decontamination cells, with adequate crane coverage.											X	No change.
33	Installation of any equipment needed in DWPF to support the alternative (fit, form, etc).												File No change.
34	Need for docking door to maintain clean crane controls and electronics.											X	No change.
35	Impact of strip effluent hold tank on DWPF nitrogen purge system.											X	No change.

ID No.	**Caustic Side Solvent Extraction** Uncertainty Statement	Areas of Uncertainty									1	2	Explanatory Notes
		Mission	Technical Maturity	Environmental	Engineering / Design	Operation	Regulatory	Stakeholder	Safety	Radiological			
36	Strategy to minimize contactor shut downs and interruptions ie. routine utility upsets do not result in process upsets											X	No change.
37	Adequate process instrumentation to detect process upsets and perform routine monitoring.											X	No change.
38	Need for additional equipment/design for the testing phase (ie. – start-up)											X	No change.
39	Strategy for disposal of special cold chemicals from cold chemical start-up tests.												File No change.
40	Inability to clean the solvent												File No change.

ID No.	**Caustic Side Solvent Extraction** Uncertainty Statement	Areas of Uncertainty									1	2	Explanatory Notes
		Mission	Technical Maturity	Environmental	Engineering / Design	Operation	Regulatory	Stakeholder	Safety	Radiological			
41	Inadvertent transfer of organics to Saltstone feed storage tank(s).												File No change.
42	Addition of organic removal for raffinate may be required											X	No change.
43	Solvent dissolving undesired compounds from aqueous stream impacts quality of feed stream to DWPF.				x						X		Selected unit operations dependent upon strip effluent. No change.
44	Combination of Al, Silica, and Fe affect the ability to run this process.		x								X		These species should be included in future laboratory tests. No change.

ID No.	**Caustic Side Solvent Extraction** Uncertainty Statement	Areas of Uncertainty									1	2	Explanatory Notes
		Mission	Technical Maturity	Environmental	Engineering / Design	Operation	Regulatory	Stakeholder	Safety	Radiological			
45	Difficulty in separating the organic stream from the aqueous stream.				x						X		Assumed contactor efficiency of 95% requires confirmation. Probably important cause of solvent loss. No change.
46	Excessive solvent degradation due to radiolysis												File No change.
47	Complex unknown process measurement techniques will be required.												File No change.
48	Difficulty in filtration of sludge and/or MST will produce low filtrate flow rates and require frequent cleaning		x								X		R&D work has confirmed this risk. WSRC-TR-99-00346

ID No.	**Caustic Side Solvent Extraction** Uncertainty Statement	Areas of Uncertainty									1	2	Explanatory Notes
		Mission	Technical Maturity	Environmental	Engineering / Design	Operation	Regulatory	Stakeholder	Safety	Radiological			
49	Difficulty in resuspending MST after long quiescent period				X						X		After 60 days of settling, resuspension was not achieved with proposed flowsheet design. ORNL-TM-1999/166
50	The technical immaturity of the “Solvent System” will result in failure of the process.												File No change.
51	HLW cannot support tank blending strategies for Cs (or other species) to support process requirements.											X	No change.
52	GT73 resin will be selective to Co60 or other trace radioisotopes.												File
53	Contacting of GT-73 with organics												File No change.

ID No.	**Caustic Side Solvent Extraction** Uncertainty Statement	Areas of Uncertainty									1	2	Explanatory Notes
		Mission	Technical Maturity	Environmental	Engineering / Design	Operation	Regulatory	Stakeholder	Safety	Radiological			
54	Solid waste has no disposal routes for spent solvent											X	No change.
55	Potential nitration of organics in the strip stream												File No change.
56	Fire in the solvent extraction process												File No change.
57	Evaporator deflagration can occur												File No change.
58	Personnel exposure to the toxic solvent/diluent could occur											X	No change.
59	By-products would be carried to Saltstone in excess of permit limits												File No change.

ID No.	**Caustic Side Solvent Extraction** Uncertainty Statement	Areas of Uncertainty									1	2	Explanatory Notes
		Mission	Technical Maturity	Environmental	Engineering / Design	Operation	Regulatory	Stakeholder	Safety	Radiological			
60	Process chemistry understanding and application are still under development, resulting in 96-1 lessons learned not yet implemented		X								X		Additional R&D work needed to close out DNFSB 96-1 concerns. Some anionic impurities work was completed. No change. HLW-SDT-99-0283
61	Lack of process data will lead to a complex design												File No change.
62	Mercury removal resin (GT-73) will not work in high caustic environment (>2 Molar).												File
63	Will not be able to procure sufficient extractant quantities												File No change.
64	Production size contactors not commercially available												File No change.

ID No.	**Caustic Side Solvent Extraction** Uncertainty Statement	Areas of Uncertainty									1	2	Explanatory Notes
		Mission	Technical Maturity	Environmental	Engineering / Design	Operation	Regulatory	Stakeholder	Safety	Radiological			
65	If facility location is F Canyon, an additional transfer line may be required												File No change.
66	Based on selected location operating facilities will be impacted.												File No change.
67	Looks like reprocessing and existing facility life extension.												File No change.
68	TRU decontamination with MST is not adequate.		X								X		Kinetics for bounding plutonium is too slow. No change. WSRC-TR-99-00219 WSRC-TR-99-00286

ID No.	**Caustic Side Solvent Extraction** Uncertainty Statement	Areas of Uncertainty									1	2	Explanatory Notes
		Mission	Technical Maturity	Environmental	Engineering / Design	Operation	Regulatory	Stakeholder	Safety	Radiological			
69	TRU decontamination may require excessive MST.		X								X		Equilibrium capacity shown to be sufficient by R&D. Neptunium for Tanks 33 and 34 will require blending. No change. WSRC-TR-99-00219 WSRC-TR-99-00286
70	The neptunium content in certain HLW Tanks may impact the PA and WAC.												File No change.
71	Monitoring GT-73 performance and breakthrough.												File

ID No.	**Caustic Side Solvent Extraction** Uncertainty Statement	Areas of Uncertainty									1	2	Explanatory Notes
		Mission	Technical Maturity	Environmental	Engineering / Design	Operation	Regulatory	Stakeholder	Safety	Radiological			
72	Temperature changes or chemistry changes may cause post precipitation after the MST strike.											X	Thermodynamic calculations indicate silica and aluminum precipitation. HLW-SDT-99-0303
73	Hydrogen control in the MST strike process.											X	No change.
74	Analysis delay (1 week) in measuring for S_r DF in MST process.		x								X		Requires new analytical techniques. No change.
75	Fate and downstream impact of oxalate, after a cross flow filter cleaning operation												No change.
76	Rate of spent equipment generation and its disposal.											X	No change.

ID No.	**Caustic Side Solvent Extraction** Uncertainty Statement	Areas of Uncertainty									1	2	Explanatory Notes
		Mission	Technical Maturity	Environmental	Engineering / Design	Operation	Regulatory	Stakeholder	Safety	Radiological			
77	Minimize spark sources in H_2 rich areas.											X	No change.
78	What is the fate of Am in the process?		x								X		Does MST strike affect Am disposition? No change.
79	Process sampling strategy for Material Control and Quality.											X	No change.
80	Cold Chemical Storage controls for shelf life concerns.												File No change.
81	Tank capacity requirements to support "Drainback" concerns.											X	No change.

ID No.	**Caustic Side Solvent Extraction** Uncertainty Statement	Areas of Uncertainty									1	2	Explanatory Notes
		Mission	Technical Maturity	Environmental	Engineering / Design	Operation	Regulatory	Stakeholder	Safety	Radiological			
82	Process control strategy and human factors consideration for simplicity of operation, maintainability and material control.											X	No change.
83	Identify facilities necessary for worker protection during operation, NPH and accident conditions.											X	No change.
84	Provide adequate facilities for support personnel.											X	No change.

8.3.2 CST Non-Elutable Ion Exchange

ID No.	**CST Non-Elutable Ion Exchange** Uncertainty Statement	Areas of Uncertainty									1	2	Explanatory Notes
		Mission	Technical Maturity	Environmental	Engineering / Design	Operation	Regulatory	Stakeholder	Safety	Radiological			
1	What happens to the resin and cesium in a loaded column under accident conditions?											X	No change.
2	The neptunium content in certain HLW Tanks may impact the PA and WAC.												File No change.
3	What is the fate of Am in the process?		x								X		Does MST strike affect Am disposition? No change.
4	Can not sample and analyze composition of CST in conjunction with other DWPF feed components?											X	No change.

ID No.	**CST Non-Elutable Ion Exchange** Uncertainty Statement	Areas of Uncertainty									1	2	Explanatory Notes
		Mission	Technical Maturity	Environmental	Engineering / Design	Operation	Regulatory	Stakeholder	Safety	Radiological			
5	Can not meet the glass composition EA standards and processing limit?		x								X		R&D results indicate CST glass is durable and not predictable. WSRC-TR-99-00245
6	Can homogeneity be maintained in the slurry, in particle size, in sampling, and transfer?				x						X		R&D results indicate hydraguard sampling modifications are required. WSRC-RP-99-00232
7	Can we satisfy test requirements with limited access to DWPF?											X	No change.
8	More variables to control and the impact on the process. (MST and Sludge, CST, Sludge, Frit).											X	No change.

ID No.	**CST Non-Elutable Ion Exchange** Uncertainty Statement	Areas of Uncertainty									1	2	Explanatory Notes
		Mission	Technical Maturity	Environmental	Engineering / Design	Operation	Regulatory	Stakeholder	Safety	Radiological			
9	Product composition models need to be changed to include CST elements.											X	Durability prediction model requires updating. WSRC-TR-99-00245
10	How do the proprietary constituents of CST affect the integrated flowsheet?		X								X		Proprietary constituents were demonstrated to precipitate and leach from resin. ORNL/TM-1999/233
11	How do you manage H_2 in the spent resin vessel?											X	No change.
12	Is there adequate heat removal in the spent resin vessel for normal operations and accidents situations?											X	No change.

ID No.	**CST Non-Elutable Ion Exchange** Uncertainty Statement	Areas of Uncertainty									1	2	Explanatory Notes
		Mission	Technical Maturity	Environmental	Engineering / Design	Operation	Regulatory	Stakeholder	Safety	Radiological			
13	Control of spent CST resin spills and material recovery.											X	No change.
14	How can you keep your sluice line from plugging?											X	No change.
15	Inability to remove spent resin from a column.									x	X		Need contingency for unloading resin from a column that is plugged. R&D demonstrated normal column resin unloading. ORNL/TM-1999/103
16	Slurry (loaded CST) abrasion/erosion problems on coils and agitators, pumps & valves.											X	No change.

ID No.	**CST Non-Elutable Ion Exchange** Uncertainty Statement	Areas of Uncertainty									1	2	Explanatory Notes
		Mission	Technical Maturity	Environmental	Engineering / Design	Operation	Regulatory	Stakeholder	Safety	Radiological			
17	Liquid level control needed in spent resin tank. (Evaporation effects)											X	No change.
18	Method of flow control between columns (pumping/gravity)											X	Demonstrated down-flow configuration with gas disengagement from the bottom of the column. ORNL/TM-1999/103
19	How is resin bed temperature control maintained?				x						X		High curie loading implies the need for more robust heat removal. No change.
20	Column pressurization scenario will require pressure relief.											X	Design should not include rupture disc. No change.

ID No.	**CST Non-Elutable Ion Exchange** Uncertainty Statement	Areas of Uncertainty									1	2	Explanatory Notes
		Mission	Technical Maturity	Environmental	Engineering / Design	Operation	Regulatory	Stakeholder	Safety	Radiological			
21	Corrosion and pluggage of resin Johnson screen.											X	No change.
22	Remotability and replacement of resin Johnson screen.											X	No change.
23	Filtration method for fines in high caustic environment.											X	No change.
24	Adequacy of monitoring system to determine when to change out columns.											X	No change.
25	Ensure installation of sample points after each column for startup and operations.											X	No change.

ID No.	**CST Non-Elutable Ion Exchange** Uncertainty Statement	Areas of Uncertainty									1	2	Explanatory Notes
		Mission	Technical Maturity	Environmental	Engineering / Design	Operation	Regulatory	Stakeholder	Safety	Radiological			
26	Resin blinding with H_2, O_2 NH_3 and steam during no flow and restart conditions.											X	Need degassing strategy for the resin. No change.
27	Potential for channeling in the column and remotability of redistributors.											X	No change.
28	Mis-sequencing of the column feed carousel during transition from salt solution to water.											X	No change.
29	Switching feeds (pH) may cause precipitation (AL) in the column.											X	No change.

ID No.	**CST Non-Elutable Ion Exchange** Uncertainty Statement	Areas of Uncertainty									1	2	Explanatory Notes
		Mission	Technical Maturity	Environmental	Engineering / Design	Operation	Regulatory	Stakeholder	Safety	Radiological			
30	Temperature changes or chemistry changes may cause post precipitation after the MST strike.		X								X		Thermodynamic calculations indicate aluminum and silica precipitation is probable. HLW-SDT-99-0303
31	Dumping the resin out the bottom of the column will hurt the DF after adding fresh resin if residue is left behind.												File No change.
32	Potential for breakthrough and transfer of solids to columns from MST Strike.											X	No change.
33	Hydrogen control in the MST strike process.											X	No change.

ID No.	**CST Non-Elutable Ion Exchange** Uncertainty Statement	Areas of Uncertainty									1	2	Explanatory Notes
		Mission	Technical Maturity	Environmental	Engineering / Design	Operation	Regulatory	Stakeholder	Safety	Radiological			
34	Analysis delay (1 week) in measuring for S_r DF in MST process.		x								X		Requires new analytical techniques. No change.
35	Can the spent resin be converted from granular engineered form to fine powder easily with mixing and high shear? This can improve transfer, sampling, and homogeneity.											X	No change.
36	Can pressure gradients crush the resin during column operations?				x						X		May generate excess fines and reduce filter efficiency. No change.
37	Contingency to replace CST with elutable resin.												File No change.

ID No.	**CST Non-Elutable Ion Exchange** Uncertainty Statement	Areas of Uncertainty									1	2	Explanatory Notes
		Mission	Technical Maturity	Environmental	Engineering / Design	Operation	Regulatory	Stakeholder	Safety	Radiological			
38	Application of carousel design in a remote environment (eg operation and maintenance of valves).				x						X		Hanford has experienced major problems. Multiple column connections and valve concerns. No change.
39	Temperature monitoring in column can be used for loading profile											X	No change.
40	Fate and downstream impact of oxalate, after a cross flow filter cleaning operation												File No change.
41	Rate of spent equipment generation and its disposal.											X	No change.

ID No.	**CST Non-Elutable Ion Exchange** Uncertainty Statement	Areas of Uncertainty									1	2	Explanatory Notes
		Mission	Technical Maturity	Environmental	Engineering / Design	Operation	Regulatory	Stakeholder	Safety	Radiological			
42	Deconning of equipment may be difficult because of fines.											X	No change.
43	Fines accumulation of loaded CST in process ventilation system results in very hot system.											X	No change.
44	Is the shielding in the current transfer lines adequate for transferring spent/ loaded resin?									x	X		Current transfer lines designed for 40 curies/gallon versus potentially 500 curies/gallon. No change.
45	How do you manage large curie inventories in facilities?												File No change.
46	Failure of seals, elastomers, etc...from high rad field.											X	No change.

ID No.	**CST Non-Elutable Ion Exchange** Uncertainty Statement	Areas of Uncertainty									1	2	Explanatory Notes
		Mission	Technical Maturity	Environmental	Engineering / Design	Operation	Regulatory	Stakeholder	Safety	Radiological			
47	Need for cell-to-clean-area isolation. (eg. Impulse lines, transfer pumps)											X	No change.
48	Disposal method for clean CST fines.											X	No change.
49	Impact of SME and SRAT carry-over of CST fines DWPF recycle.											X	Evaporator installed in DWPF would mitigate the recycle concern. No change. WSRC-RP-99-00005
50	Minimize spark sources in H_2 rich areas.											X	No change.
51	Monitoring GT-73 performance and breakthrough.												File

ID No.	**CST Non-Elutable Ion Exchange** Uncertainty Statement	Areas of Uncertainty									1	2	Explanatory Notes
		Mission	Technical Maturity	Environmental	Engineering / Design	Operation	Regulatory	Stakeholder	Safety	Radiological			
52	Difficulty in maintaining remote safety class pressure relief valves.											X	No change.
53	Level of functional testing required.											X	No change.
54	How to test a freshly filled column prior to feeding waste. (mode switching).											X	No change.
55	TRU decontamination may require excessive MST.		X								X		Equilibrium capacity shown to be sufficient by R&D. Neptunium for Tanks 33 and 34 will require blending. WSRC-TR-99-00219 WSRC-TR-99-00286

ID No.	**CST Non-Elutable Ion Exchange** Uncertainty Statement	Areas of Uncertainty									1	2	Explanatory Notes
		Mission	Technical Maturity	Environmental	Engineering / Design	Operation	Regulatory	Stakeholder	Safety	Radiological			
56	Catalytic H2 production from Formic Acid in DWPF greater than Authorization Basis (AB) assumptions due to CST.											X	R&D results indicate H_2 generation rate less than AB assumptions. WSRC-TR-99-00302
57	The process technology for the SRS application of CST is not demonstrated; therefore, the design may not meet performance requirements.		x								X		Pilot demonstration needed. No change.
58	MST/CST (10%) will have deleterious effects on the glass form due to precipitation of TiO2 in glass.												File No change.

ID No.	**CST Non-Elutable Ion Exchange** Uncertainty Statement	Areas of Uncertainty									1	2	Explanatory Notes
		Mission	Technical Maturity	Environmental	Engineering / Design	Operation	Regulatory	Stakeholder	Safety	Radiological			
59	High thermal loads in columns will result in degradation and unacceptable column performance.											X	No change.
60	CST cannot be maintained in a homogeneous mixture in SME Sample and MFT Feed.												File No change. WSRC-RP-99-0232 WSRC-TR-99-00309
61	Difficulty in filtration of sludge and/or MST will produce low filtrate flow rates and require frequent cleaning		x								X		R&D work has confirmed this risk. WSRC-TR-99-00346

ID No.	**CST Non-Elutable Ion Exchange** Uncertainty Statement	Areas of Uncertainty									1	2	Explanatory Notes
		Mission	Technical Maturity	Environmental	Engineering / Design	Operation	Regulatory	Stakeholder	Safety	Radiological			
62	Inability to transfer the CST slurry in a controlled manner				X						X		In preparation for the hydrogen generation test size reduced CST was observed to pack and not resuspend. WSRC-TR-99-00302
63	Difficulty in resuspending MST after long quiescent period				X						X		After 60 days of settling, resuspension was not achieved with proposed flowsheet design. ORNL-TM-1999/166
64	HLW cannot support tank blending strategies for Cs (or other species) to support process requirements.											X	No change.
65	Get CST in recycle stream from DWPF												File No change. WSRC-RP-99-00005

ID No.	**CST Non-Elutable Ion Exchange** Uncertainty Statement	Areas of Uncertainty									1	2	Explanatory Notes
		Mission	Technical Maturity	Environmental	Engineering / Design	Operation	Regulatory	Stakeholder	Safety	Radiological			
66	GT73 resin will be selective to Co60 or other trace radioisotopes.												File
67	Failure to use MST on the front end will lead to criticality on CST.												File No change.
68	Deflagration of resin column due to radiolysis of water (H2 generation).												File No change.
69	Steam pressurization of resin column												File R&D results indicate H_2 generation rate is less than AB assumptions. No change.
70	Catalytic H2 production in DWPF greater than Authorization Basis due to CST.												File WSRC-TR-99-00302

ID No.	**CST Non-Elutable Ion Exchange** Uncertainty Statement	Areas of Uncertainty									1	2	Explanatory Notes
		Mission	Technical Maturity	Environmental	Engineering / Design	Operation	Regulatory	Stakeholder	Safety	Radiological			
71	CST will require “requalification” of glass form												File WSRC-TR-99-00245
72	Expensive and complex material handling system for moving CST slurry.												File No change.
73	No means to adequately analyze CST in DWPF												File No change.
74	Mercury removal resin (GT-73) will not work in high caustic environment (>2 Molar).												File
75	The CST material may not be available in sufficient quantities to support the process (50 tons per year).					x					X		

ID No.	**CST Non-Elutable Ion Exchange** Uncertainty Statement	Areas of Uncertainty									1	2	Explanatory Notes
		Mission	Technical Maturity	Environmental	Engineering / Design	Operation	Regulatory	Stakeholder	Safety	Radiological			
76	Major sample station modifications affecting DWPF operations.					X					X		
77	TRU decontamination with MST is not adequate.		**X**								X		Kinetics for bounding plutonium is too slow. WSRC-TR-99-00219 WSRC-TR-99-00286
78	Accumulation of hydrogen may occur in vapor spaces (including process vessels) and deflagrations/detonation could occur if there is a spark source.											X	No change.

ID No.	**CST Non-Elutable Ion Exchange** Uncertainty Statement	Areas of Uncertainty									1	2	Explanatory Notes
		Mission	Technical Maturity	Environmental	Engineering / Design	Operation	Regulatory	Stakeholder	Safety	Radiological			
79	Process sampling strategy for Material Control and Quality.											X	No change.
80	Cold Chemical Storage controls for shelf life concerns.												File No change.
81	Tank capacity requirements to support "Drainback" concerns.											X	No change.
82	Process control strategy and human factors consideration for simplicity of operation, maintainability and material control.											X	No change.

ID No.	**CST Non-Elutable Ion Exchange** Uncertainty Statement	Areas of Uncertainty									1	2	Explanatory Notes
		Mission	Technical Maturity	Environmental	Engineering / Design	Operation	Regulatory	Stakeholder	Safety	Radiological			
83	Identify facilities necessary for worker protection during operation, NPH and accident conditions.											X	No change.
84	Provide adequate facilities for support personnel.											X	No change.
85	Existing transfer lines and tank size and drain back not adequate, and leads to inefficiencies.											X	No change.
86	Solids on filters will not dissolve or would be difficult to dissolve in oxalic acid.												File No change.

ID No.	**CST Non-Elutable Ion Exchange** Uncertainty Statement	Areas of Uncertainty									1	2	Explanatory Notes
		Mission	Technical Maturity	Environmental	Engineering / Design	Operation	Regulatory	Stakeholder	Safety	Radiological			
87	Require adequate size of remote and contact decontamination cells, with adequate crane coverage.											X	No change.
88	Need for docking door to maintain clean crane controls and electronics.											X	No change.
89	Adequate process instrumentation to detect process upsets and perform routine monitoring.											X	No change.

ID No.	**CST Non-Elutable Ion Exchange** Uncertainty Statement	Areas of Uncertainty									1	2	Explanatory Notes
		Mission	Technical Maturity	Environmental	Engineering / Design	Operation	Regulatory	Stakeholder	Safety	Radiological			
90	Process chemistry understanding and application are still under development, resulting in 96-1 lessons learned not yet implemented		x								X		Product is considered to be under development and by experiment, has exhibited stability and leaching problems. ORNL/TM-1999/233

8.3.3 Direct Disposal in Grout

ID No.	**Direct Disposal in Grout** Uncertainty Statement	Areas of Uncertainty									1	2	Explanatory Notes
		Mission	Technical Maturity	Environmental	Engineering / Design	Operation	Regulatory	Stakeholder	Safety	Radiological			
1	Oxidation of sulfides during curing at high temperature while exposed to the air will increase leachability of grout (e.g., technetium, chrome, mercury).											X	The final grout formulation will define temperature limits to be applied in the design process. No Change.
2	Accumulation of hydrogen may occur in vapor spaces (including process vessels) and deflagrations/detonation could occur if there is a spark source.											X	No Change.

ID No.	**Direct Disposal in Grout** Uncertainty Statement	Areas of Uncertainty									1	2	Explanatory Notes
		Mission	Technical Maturity	Environmental	Engineering / Design	Operation	Regulatory	Stakeholder	Safety	Radiological			
3	H_2 Generation in grout could degrade the waste form.												File No Change.
4	Water expulsion from monolith due to displacement by radiolytic gas could occur.												File No Change.

ID No.	**Direct Disposal in Grout** Uncertainty Statement	Areas of Uncertainty									1	2	Explanatory Notes
		Mission	Technical Maturity	Environmental	Engineering / Design	Operation	Regulatory	Stakeholder	Safety	Radiological			
5	Existing vault design may have to be upgraded with liners, ventilation upgrades, temperature monitoring, leachate collection, capping/backfilling, elimination of floor penetrations, HEPA filtration of moist atmosphere and the addition of cell access for failed equipment disposal.				**X**						**X**		Some of these additional design features could be complex and expensive. No Change.

ID No.	**Direct Disposal in Grout** Uncertainty Statement	Areas of Uncertainty									1	2	Explanatory Notes
		Mission	Technical Maturity	Environmental	Engineering / Design	Operation	Regulatory	Stakeholder	Safety	Radiological			
6	Developing a formulation capable of maintaining structural and chemical integrity after extended curing of grout at up to 90 °C may not be possible.		x								**X**		While the research program should resolve this issue, the grout formulation is currently unknown. Additional development funding may be required. No Change.
7	It may be necessary to remove the nitrates to improve the PA.												File No Change.
8	If the monolith cracks more due to higher Cs loading, does the movement of materials to the ground water increase?												File No Change. WSRC-TR-99-00227

ID No.	**Direct Disposal in Grout** Uncertainty Statement	Areas of Uncertainty									1	2	Explanatory Notes
		Mission	Technical Maturity	Environmental	Engineering / Design	Operation	Regulatory	Stakeholder	Safety	Radiological			
9	More vault cells may be needed to manage curing temperatures.											X	No Change.
10	It may be difficult to keep grout lines clear with available equipment.											X	No Change.
11	Are multiple holdup tanks needed to isolate "Bad Batches"?											X	No Change.
12	Is there a problem with variability due to ETF feed?												File No Change.
13	May need remote sampling and testing facility.											X	No Change.
14	Equipment will require remote maintenance.											X	No Change.

ID No.	**Direct Disposal in Grout** Uncertainty Statement	Areas of Uncertainty									1	2	Explanatory Notes
		Mission	Technical Maturity	Environmental	Engineering / Design	Operation	Regulatory	Stakeholder	Safety	Radiological			
15	May need to evaluate existing PMTs and designed on-the-shelf saltstone upgrades.												File No Change.
16	May need backup power or other motive forces for flushing to avoid grouting the system solid.											X	No Change.
17	Design consideration for erosion/corrosion, spares, and material compatibility consideration has to be provided.											X	No Change.

ID No.	**Direct Disposal in Grout** Uncertainty Statement	Areas of Uncertainty									1	2	Explanatory Notes
		Mission	Technical Maturity	Environmental	Engineering / Design	Operation	Regulatory	Stakeholder	Safety	Radiological			
18	The neptunium content in certain HLW Tanks may impact the PA and WAC.												File No Change.
19	Lines are cleaned of blockage by "Shutdown Process" with batch lost. Does this unacceptably hurt production?												File No Change.
20	Operations cannot "Operate" for 8 hours in a 10 hour day. Probably need 16 hours (2 shifts).												File No Change.
21	Dry material delivery and handling may be a problem at high production rates.											X	No Change.

ID No.	**Direct Disposal in Grout** Uncertainty Statement	Areas of Uncertainty									1	2	Explanatory Notes
		Mission	Technical Maturity	Environmental	Engineering / Design	Operation	Regulatory	Stakeholder	Safety	Radiological			
22	May need to do adequate cold (simulant) testing to support "HOT" testing.												File No Change.
23	Process chemistry understanding and application are still under development, resulting in 96-1 lessons learned not yet implemented		x								X		Additional R&D work needed to close out DNFSB 96-1 concerns. No Change.
24	Remote equipment handling demonstration.											X	No Change.
25	Establishment of dry material specifications and acceptance testing may be required. Temperature may be significant.											X	No Change.

ID No.	**Direct Disposal in Grout** Uncertainty Statement	Areas of Uncertainty									1	2	Explanatory Notes
		Mission	Technical Maturity	Environmental	Engineering / Design	Operation	Regulatory	Stakeholder	Safety	Radiological			
26	More operators may be needed due to saltstone layout and I & C. Optimization is needed. (Controls location too far apart. Packages don't communicate).											X	No Change.
27	Are there radiation effects on equipment in Vault? CCTVs, wiring, gaskets, seals, insulation, etc. (Disposable TV's vs RAD-Hardened).											X	No Change.
28	"Hot" testing to verify process chemistry may be needed.												File No Change.

ID No.	**Direct Disposal in Grout** Uncertainty Statement	Areas of Uncertainty									1	2	Explanatory Notes
		Mission	Technical Maturity	Environmental	Engineering / Design	Operation	Regulatory	Stakeholder	Safety	Radiological			
29	Cs-135 concentrations may impact the Performance Assessment (PA).						**X**				**X**		Current PA does not address Cs-135. No Change.
30	If process design matures prior to grout formulation the product quality may be at risk.												File No Change.
31	Difficulty in filtration of sludge and/or MST will produce low filtrate flow rates and require frequent cleaning		x								X		R&D work has confirmed this risk. WSRC-TR-99-00346
32	TRU decontamination with MST is not adequate.		**X**								X		Kinetics for bounding plutonium is too slow. WSRC-TR-99-00219 WSRC-TR-99-00286

ID No.	**Direct Disposal in Grout** Uncertainty Statement	Areas of Uncertainty									1	2	Explanatory Notes
		Mission	Technical Maturity	Environmental	Engineering / Design	Operation	Regulatory	Stakeholder	Safety	Radiological			
33	MST amount needed for decontamination exceeds DWPF Ti glass limits.											X	MST concentration of 0.4 g/L makes acceptable glass. WSRC-TR-99-00332
34	TRU decontamination may require excessive MST.		X								X		Equilibrium capacity shown to be sufficient by R&D. Neptunium for Tanks 33 and 34 will require blending. WSRC-TR-99-00219 WSRC-TR-99-00286
35	Inability to develop a grout formulation for increased Cs & K and Salt Molarity concentration.											X	No change.
36	Grout temperature too high to make acceptable grout											X	No change. WSRC-TR-99-00227

ID No.	**Direct Disposal in Grout** Uncertainty Statement	Areas of Uncertainty									1	2	Explanatory Notes
		Mission	Technical Maturity	Environmental	Engineering / Design	Operation	Regulatory	Stakeholder	Safety	Radiological			
37	Existing grout equipment requires hands on maintenance negatively affecting potential personnel exposure and attainment.											X	No change.
38	Difficulty in resuspending MST after long quiescent period											X	After 60 days of settling, resuspension was not achieved with proposed flowsheet design. ORNL-TM-1999/166
39	HLW cannot support tank blending strategies for Cs (or other species) to support process requirements.											X	No change.
40	GT73 resin will be selective to Co60 or other trace radioisotopes.												File

ID No.	**Direct Disposal in Grout** Uncertainty Statement	Areas of Uncertainty									1	2	Explanatory Notes
		Mission	Technical Maturity	Environmental	Engineering / Design	Operation	Regulatory	Stakeholder	Safety	Radiological			
41	No ability to dispose of failed contaminated equipment.												File No change.
42	Burn, deflagration, detonation to radiolytic H2 in the vaults.											X	No change.
43	Loss of grout cooling results in organics and/or Cs releases											X	No change. WSRC-TR-99-00227
44	Seismic event results in a slurry spill.											X	No change.
45	The volume of Class C waste exceeds the NRC interpretation for percent of low level waste and will not be allowed.												File No change.

ID No.	**Direct Disposal in Grout** Uncertainty Statement	Areas of Uncertainty									1	2	Explanatory Notes
		Mission	Technical Maturity	Environmental	Engineering / Design	Operation	Regulatory	Stakeholder	Safety	Radiological			
46	The new process will be perceived as not removing key radionuclides to the maximum extent that is technically and economically practical and will not be allowed.												File No change.
47	Mercury removal resin (GT-73) will not work in high caustic environment (>2 Molar).												File
48	Shielded cell capacity does not support hot grout analysis.											X	No change.
49	Process will be found unacceptable by vital stakeholders.												File No change.
50	Monitoring GT-73 performance and breakthrough.												File

ID No.	**Direct Disposal in Grout** Uncertainty Statement	Areas of Uncertainty: Mission	Technical Maturity	Environmental	Engineering / Design	Operation	Regulatory	Stakeholder	Safety	Radiological	1	2	Explanatory Notes
51	Temperature changes or chemistry changes may cause post precipitation after the MST strike.												File No change.
52	Hydrogen control in the MST strike process.											X	No change.
53	Analysis delay (1 week) in measuring for S_r DF in MST process.		X								X		Requires new analytical techniques. No change.
54	Fate and downstream impact of oxalate, after a cross flow filter cleaning operation												File No change.

ID No.	**Direct Disposal in Grout** Uncertainty Statement	Areas of Uncertainty									1	2	Explanatory Notes
		Mission	Technical Maturity	Environmental	Engineering / Design	Operation	Regulatory	Stakeholder	Safety	Radiological			
55	Rate of spent equipment generation and its disposal.											X	No change.
56	Minimize spark sources in H_2 rich areas.											X	No change.
57	What is the fate of Am in the process?		x								X		Does MST strike affect Am disposition? No change.
58	Process sampling strategy for Material Control and Quality.											X	No change.
59	Cold Chemical Storage controls for shelf life concerns.												File No change.
60	Tank capacity requirements to support "Drainback" concerns.											X	No change.

ID No.	**Direct Disposal in Grout** Uncertainty Statement	Areas of Uncertainty									1	2	Explanatory Notes
		Mission	Technical Maturity	Environmental	Engineering / Design	Operation	Regulatory	Stakeholder	Safety	Radiological			
61	Process control strategy and human factors consideration for simplicity of operation, maintainability and material control.											X	No change.
62	Identify facilities necessary for worker protection during operation, NPH and accident conditions.											X	No change.
63	Provide adequate facilities for support personnel.											X	No change.
64	Existing transfer lines and tank size and drain back not adequate, and leads to inefficiencies.											X	No change.

ID No.	**Direct Disposal in Grout** Uncertainty Statement	Areas of Uncertainty									1	2	Explanatory Notes
		Mission	Technical Maturity	Environmental	Engineering / Design	Operation	Regulatory	Stakeholder	Safety	Radiological			
65	Solids on filters will not dissolve or would be difficult to dissolve in oxalic acid.												File No change.
66	Require adequate size of remote and contact decontamination cells, with adequate crane coverage.											X	No change.
67	Need for docking door to maintain clean crane controls and electronics.											X	No change.
68	Adequate process instrumentation to detect process upsets and perform routine monitoring.											X	No change.

7.3.4 Small Tank TPB Precipitation

ID No.	**Small Tank TPB Precipitation** Uncertainty Statement	Areas of Uncertainty									1	2	Explanatory Notes
		Mission	Technical Maturity	Environmental	Engineering / Design	Operation	Regulatory	Stakeholder	Safety	Radiological			
1	Loss of cooling event - How hot will the precipitate get from the Cesium decay heat and resulting benzene generation?											X	No change.
2	Benzene release after power loss could result in exceeding LFL in the process cells.											X	No change.
3	Does MST carry down catalysts or concentrate them?												File No change.

ID No .	**Small Tank TPB Precipitation** Uncertainty Statement	Areas of Uncertainty									1	2	Explanatory Notes
		Mission	Technical Maturity	Environmental	Engineering / Design	Operation	Regulatory	Stakeholder	Safety	Radiological			
4	Close coupled unit operations adds production complexity. Salt Cell in DWPF has to be operated in this option.					**X**					**X**		Assumes undemonstrated operation efficiencies in the LCC basis. Hydrolysis steps could be performed in new facility. No change.
5	How do you recover from a batch that decomposes? Need capability to deinventory tanks and recycle.					X					X		Catalyst activation greater than the bounding case results in a loss of product DF.
6	If the Batch Decomposes, recycling will only repeat the problem. Need a hold tank to treat.					X					X		Catalyst activation greater than the bounding case results in a loss of product DF.

ID No.	**Small Tank TPB Precipitation** Uncertainty Statement	Areas of Uncertainty									1	2	Explanatory Notes
		Mission	Technical Maturity	Environmental	Engineering / Design	Operation	Regulatory	Stakeholder	Safety	Radiological			
7	Benzene releases may exceed permit levels due to additional (unknown) catalytic effects or catalyst build-up through plate-out.		**X**								**X**		Uncertainty dependent on R&D results. Minor if permit limits are protected. Catalyst activation greater than the bounding case results in a loss of product DF. No change.
8	How do we know when we get to 10% precipitate concentration?												File No change.
9	Process sampling strategy for Material Control and Quality.											X	No change.
10	Instrumentation control for safety protection strategy.											X	No change.

ID No.	**Small Tank TPB Precipitation** Uncertainty Statement	Areas of Uncertainty									1	2	Explanatory Notes
		Mission	Technical Maturity	Environmental	Engineering / Design	Operation	Regulatory	Stakeholder	Safety	Radiological			
11	How long is the storage time for the NaTPB? Shelf life and benzene release.												File No change.
12	Ventilation considerations for vessel ventilation addressing material carry over to filtration material. Potential for organics and nitrates in the HEPA filters and ventilation system.											X	No change.
13	Training for maintenance and operations personnel to support facility operation (unique equipment and instruments).												File No change.

ID No.	**Small Tank TPB Precipitation** Uncertainty Statement	Areas of Uncertainty									1	2	Explanatory Notes
		Mission	Technical Maturity	Environmental	Engineering / Design	Operation	Regulatory	Stakeholder	Safety	Radiological			
14	Cold Chemical Storage controls for shelf life concerns.												File No change.
15	Tank In-Leakage impacts of process chemistry controls.											X	No change.
16	Material settles or plates out in the tank and concentrates.												File No change.
17	Difficulty to transfer 10 W% slurry to DWPF because of high viscosity.											X	No change. WSRC-TR-99-00243
18	Effect of materials of construction on catalytic effect.											X	No change.

ID No.	**Small Tank TPB Precipitation** Uncertainty Statement	Areas of Uncertainty									1	2	Explanatory Notes
		Mission	Technical Maturity	Environmental	Engineering / Design	Operation	Regulatory	Stakeholder	Safety	Radiological			
19	Safety strategy for MOC control in process vessels and LFL control for building air space.											X	No change.
20	Erosion and Corrosion considerations for material of construction impact on equipment life and maintenance requirements. Material compatibility (gaskets/seals)											X	No change.
21	Tank capacity requirements to support "Drainback" concerns.											X	No change.

ID No.	**Small Tank TPB Precipitation** Uncertainty Statement	Areas of Uncertainty: Mission	Technical Maturity	Environmental	Engineering / Design	Operation	Regulatory	Stakeholder	Safety	Radiological	1	2	Explanatory Notes
22	Safety strategy for transfer paths and leak detection (benzene accumulation).											X	No change.
23	STPB impurities and quality control for impact on the process.												File No change.
24	Benzene chronic release problems. Do not over design for worker exposure based on AB or Safety Assumptions.												File No change.
25	Consider modifications for future benzene abatement in the current design process.												File No change.

ID No.	**Small Tank TPB Precipitation** Uncertainty Statement	Areas of Uncertainty									1	2	Explanatory Notes
		Mission	Technical Maturity	Environmental	Engineering / Design	Operation	Regulatory	Stakeholder	Safety	Radiological			
26	TPB process keeps adding unit operations and increases complexity to make it work and meet requirements.												File No change.
27	Process control strategy and human factors consideration for simplicity of operation, maintainability and material control.											X	No change.
28	Identify facilities necessary for worker protection during operation, NPH and accident conditions.											X	No change.
29	Provide adequate facilities for support personnel.											X	No change.

ID No.	**Small Tank TPB Precipitation** Uncertainty Statement	Areas of Uncertainty									1	2	Explanatory Notes
		Mission	Technical Maturity	Environmental	Engineering / Design	Operation	Regulatory	Stakeholder	Safety	Radiological			
30	Hazards Analysis/PHR may require isolated two train design.											X	No change.
31	Are we doing anything to keep sludge out of the process? Does doing the MST strike and sludge removal provide process benefits as a separate head end unit operation.												File No change. HLW-SDT-99-0289 WSRC-TR-99-00208
32	Does sample efficacy cover the materials that can get you in trouble?												File No change.
33	Design considerations for radiological operations and response.												File No change.

ID No.	**Small Tank TPB Precipitation** Uncertainty Statement	Areas of Uncertainty									1	2	Explanatory Notes
		Mission	Technical Maturity	Environmental	Engineering / Design	Operation	Regulatory	Stakeholder	Safety	Radiological			
34	Tank recovery strategy (Tank 48 and 49) to support operations.												File No change. WSRC-RP-99-00005
35	Filter blinding from gas entrainment and pressure drop in the filter assembly.											X	No change. WSRC-TR-99-00243 ORNL/TM-1999/234
36	What have we done to address the scale-up and variable materials for TPB hydrolysis and DWPF.											X	WSRC-TR-99-00272
37	Will CSTR negatively impact filtration rate. Based on fresh precipitate and particle size at 25 ^{o}C.											X	ORNL/TM-1999/234 WSRC-TR-99-00243

ID No.	**Small Tank TPB Precipitation** Uncertainty Statement	Areas of Uncertainty									1	2	Explanatory Notes
		Mission	Technical Maturity	Environmental	Engineering / Design	Operation	Regulatory	Stakeholder	Safety	Radiological			
38	Precipitate hydrolysis will be idle for 10 years. Equipment operational readiness.												File No change. HLW-SDT-99-0266 WSRC-RP-99-00006 WSRC-RP-99-00005
39	Radioactive waste tests to support equipment design and confirm cold test results for chemical analysis.												File No change. WSRC-TR-99-00345
40	Additional antifoam will have deleterious effects on downstream processes.		X								X		Real waste test suggest the need for a different anti-foam. WSRC-TR-99-00345

ID No.	**Small Tank TPB Precipitation** Uncertainty Statement	Areas of Uncertainty									1	2	Explanatory Notes
		Mission	Technical Maturity	Environmental	Engineering / Design	Operation	Regulatory	Stakeholder	Safety	Radiological			
41	Np decontamination may not be adequate to meet Saltstone Performance Assessment (PA).												File No change.
42	TRU decontamination may require excessive MST.		X								X		Equilibrium capacity shown to be sufficient by R&D. Neptunium for Tanks 33 and 34 will require blending. WSRC-TR-99-00219 WSRC-TR-99-00286 No change.
43	Process will not produce the dF required because of slow kinetics of MST and TPB.											X	ORNL/TM-1999/234 WSRC-TR-99-00345

ID No.	**Small Tank TPB Precipitation** Uncertainty Statement	Areas of Uncertainty									1	2	Explanatory Notes
		Mission	Technical Maturity	Environmental	Engineering / Design	Operation	Regulatory	Stakeholder	Safety	Radiological			
44	The precipitate will be difficult to filter.												File No change. WSRC-TR-99-00345 ORNL/TM-1999/234
45	Distribution of byproducts of hydrolysis reaction could be deleterious to DWPF.											X	No change.
46	Enough recycle organics from (DWPF) Salt Cell will exist to negatively affect the Tank Farm.											X	No change.
47	HLW cannot support tank blending strategies for Cs (or other species) to support process requirements.											X	No change.

ID No.	**Small Tank TPB Precipitation** Uncertainty Statement	Areas of Uncertainty									1	2	Explanatory Notes
		Mission	Technical Maturity	Environmental	Engineering / Design	Operation	Regulatory	Stakeholder	Safety	Radiological			
48	DWPF production rate (260 canisters/year) cannot be met.												File No change.
49	Late Wash Facility as designed would require modifications to support accelerated clean up plan (200 can base case / 260 can STP)												File No change.
50	Radiation exposure of personnel or contamination events may increase.												File No change.
51	Benzene deflagration in a processing tank will occur											X	No change.
52	Benzene will present worker safety hazard.												File No change.

ID No.	**Small Tank TPB Precipitation** Uncertainty Statement	Areas of Uncertainty									1	2	Explanatory Notes
		Mission	Technical Maturity	Environmental	Engineering / Design	Operation	Regulatory	Stakeholder	Safety	Radiological			
53	Process chemistry understanding and application are still under development, resulting in 96-1 lessons learned not yet implemented.		x								X		Catalyst activation greater than the bounding case results in a loss of product DF. WSRC-TR-99-00279
54	Cannot design adequate safety features to protect for all benzene generation rate(s).												File No change.
55	Stakeholders will reject the alternative												File No change.
56	MST amount needed for decontamination exceeds DWPF Ti glass limits.											X	MST concentrate of 0.4 g/L makes acceptable glass. WSRC-TR-99-00332
57	GT73 resin will be selective to Co60 or other trace radioisotopes.												File

ID No.	**Small Tank TPB Precipitation** Uncertainty Statement	Areas of Uncertainty									1	2	Explanatory Notes
		Mission	Technical Maturity	Environmental	Engineering / Design	Operation	Regulatory	Stakeholder	Safety	Radiological			
58	Mercury removal resin (GT-73) will not work in high caustic environment (>2 Molar).												File
59	Accumulation of hydrogen may occur in vapor spaces (including process vessels) and deflagrations/detonation could occur if there is a spark source.											X	No change.
60	The neptunium content in certain HLW Tanks may impact the PA and WAC.												File No change. Neptunium for Tanks 33 and 34 will require blending. WSRC-TR-99-00219 WSRC-TR-99-00286

ID No.	**Small Tank TPB Precipitation** Uncertainty Statement	Areas of Uncertainty									1	2	Explanatory Notes
		Mission	Technical Maturity	Environmental	Engineering / Design	Operation	Regulatory	Stakeholder	Safety	Radiological			
61	Difficulty in filtration of sludge and/or MST will produce low filtrate flow rates and require frequent cleaning												File WSRC-TR-99-00243 ORNL/TM-199/234**e**
62	Difficulty in resuspending MST after long quiescent period												File
63	Monitoring GT-73 performance and breakthrough.												File
64	Temperature changes or chemistry changes may cause post precipitation after the MST strike.												File No change.
65	Hydrogen control in the MST strike process.											X	No change.

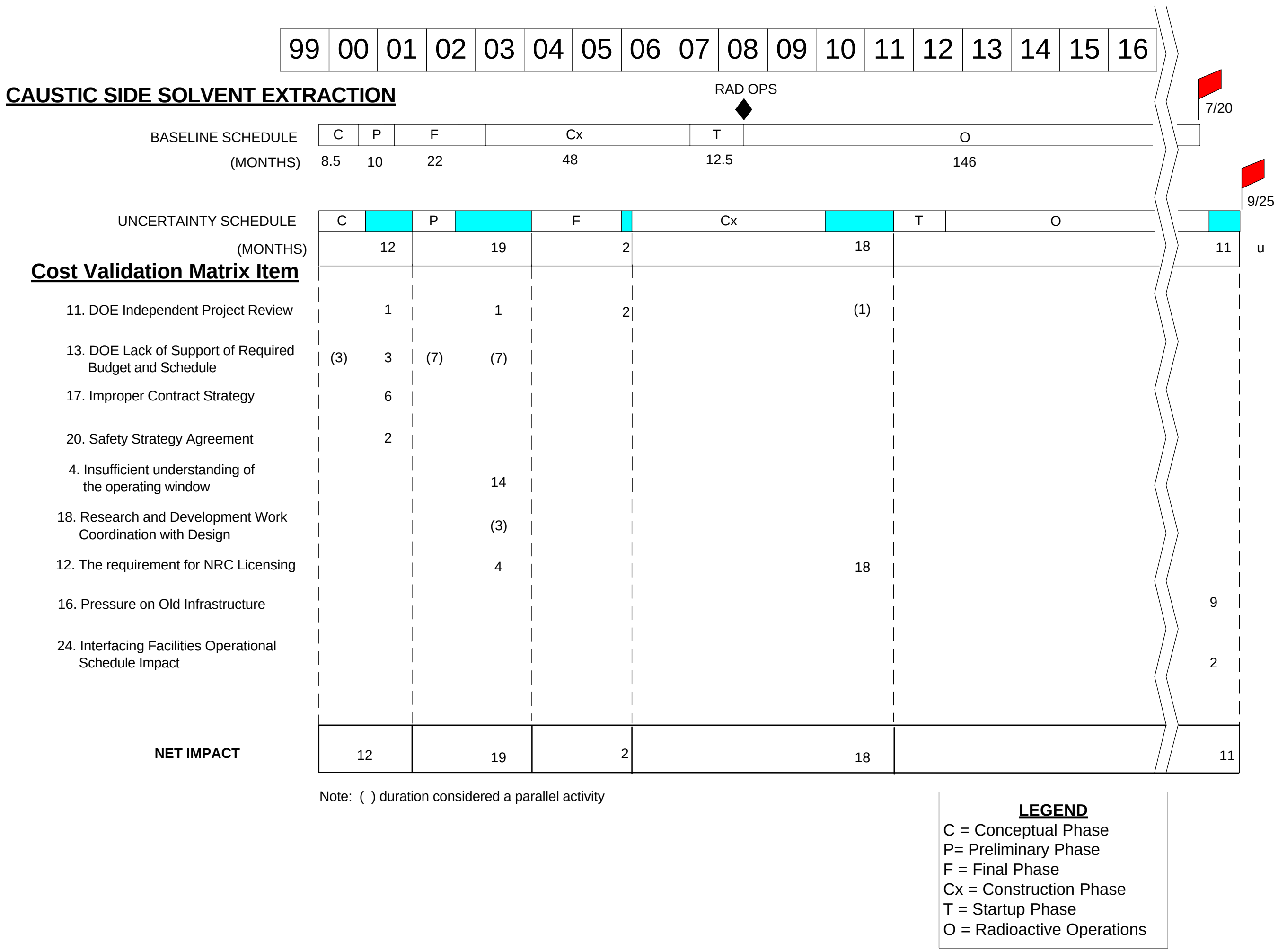
ID No.	**Small Tank TPB Precipitation** Uncertainty Statement	Areas of Uncertainty									1	2	Explanatory Notes
		Mission	Technical Maturity	Environmental	Engineering / Design	Operation	Regulatory	Stakeholder	Safety	Radiological			
66	Analysis delay (1 week) in measuring for S_r DF in MST process.		x								X		Requires new analytical techniques. No change.
67	Fate and downstream impact of oxalate, after a cross flow filter cleaning operation												File No change.
68	Rate of spent equipment generation and its disposal.											X	No change.
69	Minimize spark sources in H_2 rich areas.											X	No change.
70	What is the fate of Am in the process?		x								X		Does MST strike affect Am disposition? No change.

ID No.	**Small Tank TPB Precipitation** Uncertainty Statement	Areas of Uncertainty									1	2	Explanatory Notes
		Mission	Technical Maturity	Environmental	Engineering / Design	Operation	Regulatory	Stakeholder	Safety	Radiological			
71	Existing transfer lines and tank size and drain back not adequate, and leads to inefficiencies.											X	No change.
72	Solids on filters will not dissolve or would be difficult to dissolve in oxalic acid.												File No change.
73	Require adequate size of remote and contact decontamination cells, with adequate crane coverage.											X	No change.
74	Need for docking door to maintain clean crane controls and electronics.											X	No change.

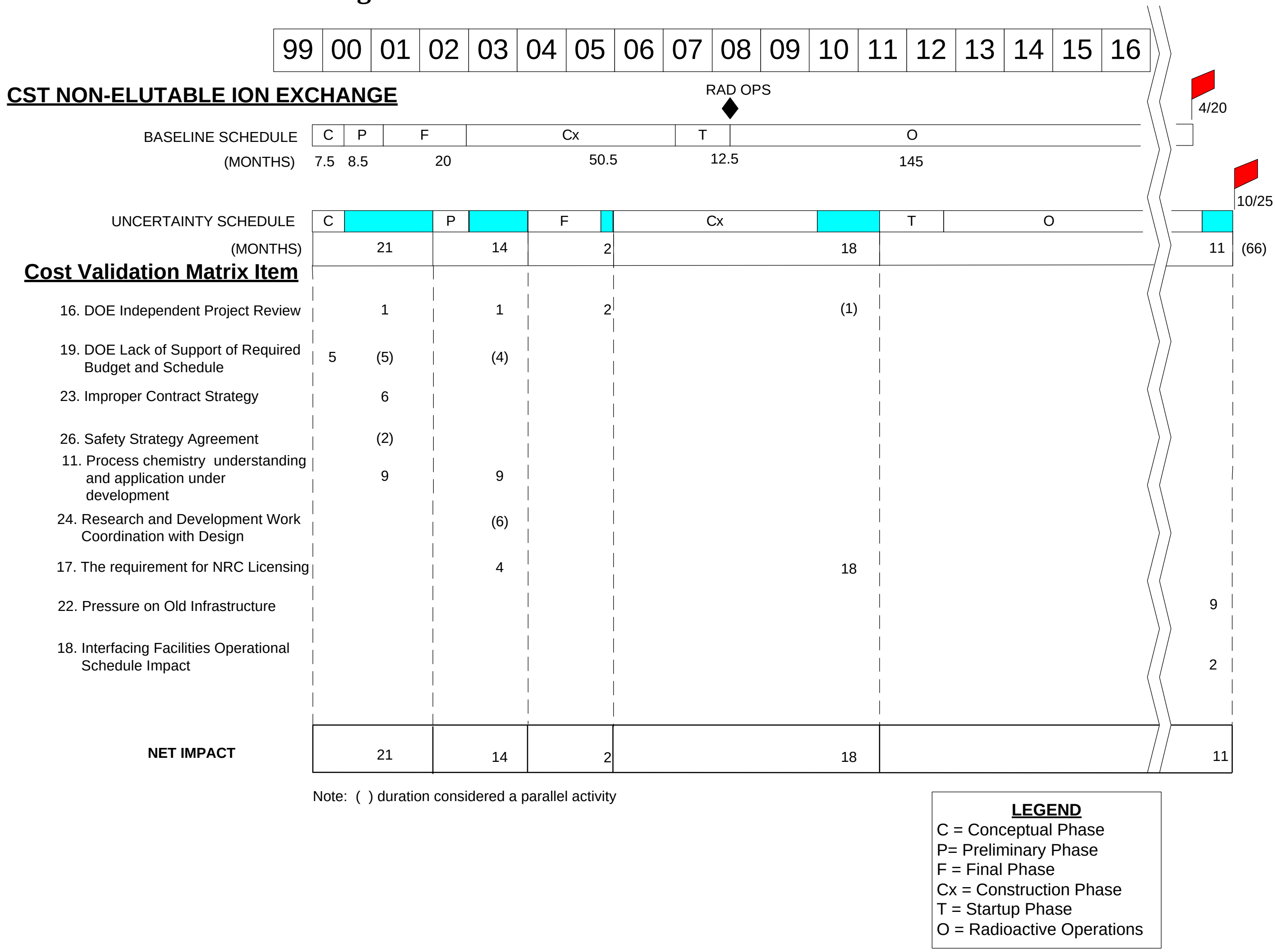
ID No.	**Small Tank TPB Precipitation** Uncertainty Statement	Areas of Uncertainty									1	2	Explanatory Notes
		Mission	Technical Maturity	Environmental	Engineering / Design	Operation	Regulatory	Stakeholder	Safety	Radiological			
75	Adequate process instrumentation to detect process upsets and perform routine monitoring.											X	No change.

8.4 Tabulated Schedule Uncertainties

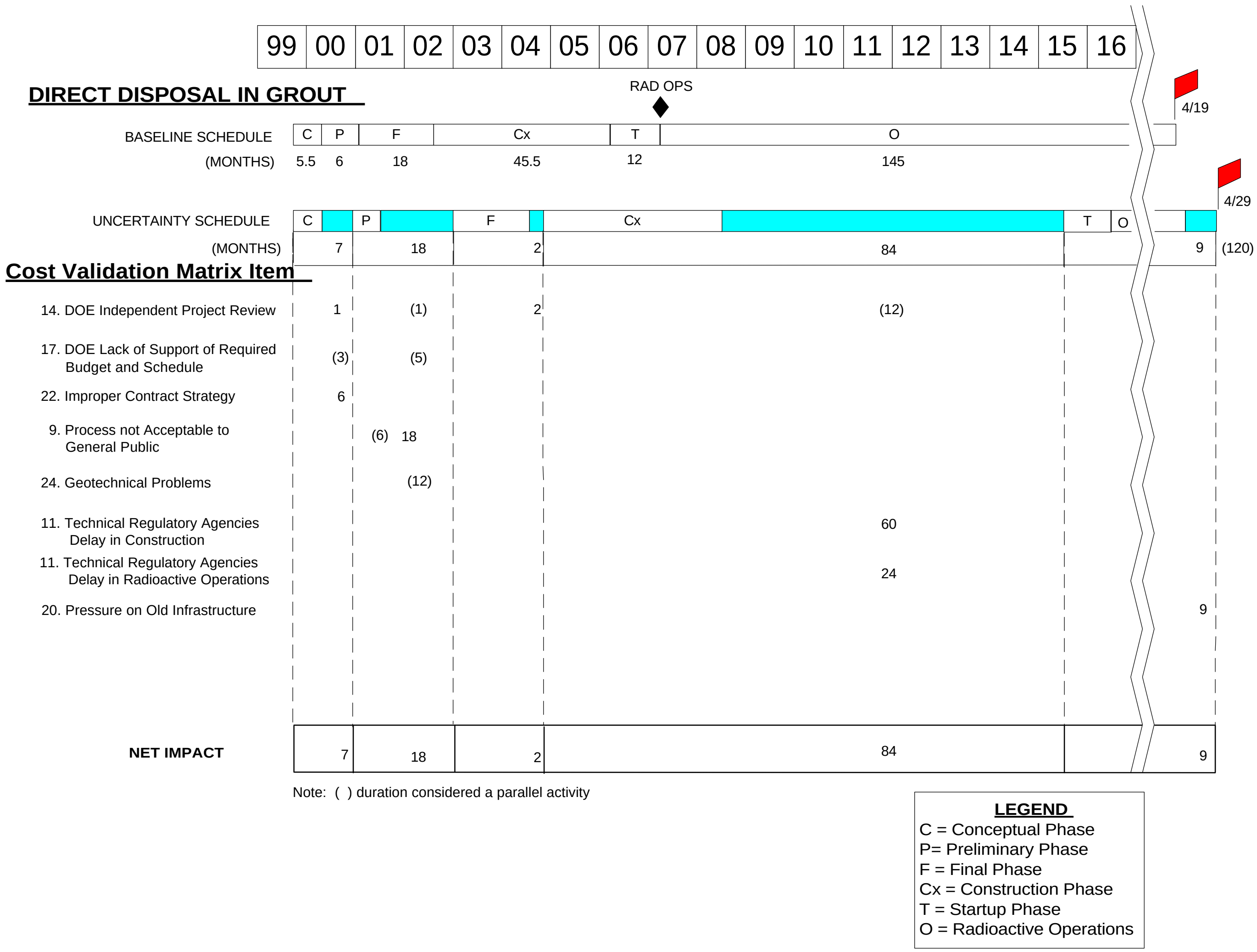
8.4.1 Caustic Side Solvent Extraction



8.4.2 CST Non-Elutable Ion Exchange



8.4.3 Direct Disposal in Grout



8.4.4 Small Tank TPB Precipitation