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ENGINEERING DATA TRANSMITTAL

1. EDT 625250

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2. To: (Receiving Organization) Document Control Services	3. From: (Originating Organization) Business Management and CFO	4. Related EDT No.: N/A
5. Proj./Prog./Dept./Div.: Tank Waste Remediation Systems (TWRS)	6. Design Authority/ Design Agent/Cog. Engr.: A.D. Basche	7. Purchase Order No.: N/A
8. Originator Remarks: This document provides a cost and schedule risk analysis of the Single-Shell Tank Interim Stabilization Project (HNF-2358, Revision 1		9. Equip./Component No.: N/A
		10. System/Bldg./Facility: N/A
11. Receiver Remarks: 11A. Design Baseline Document? [] Yes [X] No		12. Major Assm. Dwg. No.: N/A
		13. Permit/Permit Application No.: N/A
		14. Required Response Date: 8/3/98

15. DATA TRANSMITTED

(A) Item No.	(B) Document/Drawing No.	(C) Sheet No.	(D) Rev. No.	(E) Title or Description of Data Transmitted	(F) Approval Desig-nator	(G) Reason for Trans-mittal	(H) Origi-nator Dispo-sition	(I) Receiv-er Dispo-sition
1	HNF-3000		0	Single-Shell Tank Interim Risk Analysis	N/A	2	1	

16. KEY

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

17. SIGNATURE/DISTRIBUTION
(See Approval Designator for required signatures)

(G) Rea-son	(H) Disp	(J) Name (K) Signature (L) Date (M) MSIN	(G) Rea-son	(H) Disp	(J) Name (K) Signature (L) Date (M) MSIN
		Design Authority N/A	2	1	M. D. Ebben [signature] 7/31/98 H7-07
		Design Agent N/A			
2	1	Cog.Eng. N/A [signature]			
2	1	Cog. Mgr. N/A [signature]			
		QA N/A			
		Safety N/A			
		Env. N/A			

18.	19.	20.	21. DOE APPROVAL (if required) Ctrl. No.
A. D. Basche [signature] 7/31/98 Signature of EDT Date Originator	Authorized Representative Date for Receiving Organization	M. D. Ebben [signature] 7/31/98 Design Authority/ Date Cognizant Manager	[] Approved [] Approved w/comments [] Disapproved w/comments

BD-7400-172-2 (05/96) GEF097

BD-7400-172-1

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Single-Shell Tank Interim Stabilization Risk Analysis

Lockheed Martin Hanford Corporation, Richland, WA 99352
U.S. Department of Energy Contract DE-AC06-96RL13200

EDT/ECN: EDT-625250 UC: 2030
Org Code: 72000 Charge Code: E59246
B&R Code: EW3130010 Total Pages: 58

Key Words: Risk Analysis

Abstract: The purpose of the Single-Shell Tank (SST) Interim Stabilization Risk Analysis is to provide a cost and schedule risk analysis of HNF-2358, Rev. 1, "Single-Shell Tank Interim Stabilization Project Plan" (Project Plan) (Ross et al. 1998). The analysis compares the required cost profile by fiscal year (Section 4.2) and revised schedule completion date (Section 4.5) to the Project Plan. The analysis also evaluates the executability of the Project Plan and recommends a path forward for risk mitigation.

JUL 31 1998
DATE:
STA: 37
HANFORD RELEASE
ID: 22

V. L. Birkland 7/31/98

Release Approval Date Release Stamp

Approved for Public Release

RELEASE AUTHORIZATION

Document Number:	HNF-3000, Rev. 0
Document Title:	Single-Shell Tank Interim Stablization Risk Analysis

This document, reviewed in accordance with DOE Order 1430.1D, "Scientific and Technical Information Management," and DOE G 1430.1D-1, "Guide to the Management of Scientific and Technical Information," does not contain classified or sensitive unclassified information and is:

APPROVED FOR PUBLIC RELEASE

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Lockheed Martin Services, Inc.
Document Control/Information Clearance

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LIST OF TERMS

BIO	Basis for Interim Operation
CEIS	cost estimating input sheet
DCRT	double-contained receiver tank
DOE	U.S. Department of Energy
DST	double-shell tank
Ecology	Washington State Department of Ecology
EPA	U.S. Environmental Protection Agency
ESH&Q	environment, safety, health, and quality assurance
FDH	Fluor Daniel Hanford, Inc.
FY	fiscal year
I&C	instrumentation and control
LMHC	Lockheed Martin Hanford Corporation
MYWP	multi-year work plan
NOC	Notice of Construction
P3	Primavera Project Planner [1]
PBS	Project Baseline Summary
PHMC	Project Hanford Management Contract
PIC	pump instrument control
Project Plan	*Single-Shell Tank Interim Stabilization Project Plan*, Rev. 1
RAM	Reliability, Availability, Maintainability
RL	Richland Operations Office
SST	single-shell tank
TBR	Technical Basis Review
Tri-Party Agreement	*Hanford Federal Facility Agreement and Consent Order*
TRU	transuranic
TWRS	Tank Waste Remediation System
USQ	unreviewed safety question
WBS	work breakdown structure
WDOH	Washington State Department of Health

[1] Primavera Project Planner is a trademark of Primavera Systems. Inc.

SINGLE-SHELL TANK INTERIM STABILIZATION RISK ANALYSIS

1.0 OVERVIEW

The purpose of the Single-Shell Tank (SST) Interim Stabilization Risk Analysis is to provide a cost and schedule risk analysis of HNF-2358, Rev. 1, *Single-Shell Tank Interim Stabilization Project Plan* (Project Plan) (Ross et al. 1998). The analysis compares the required cost profile by fiscal year (Section 4.2) and revised schedule completion date (Section 4.5) to the Project Plan. The analysis also evaluates the executability of the Project Plan and recommends a path forward for risk mitigation (Section 5.0).

A systems engineering approach was applied to develop the Project Plan. Program and Level 1 Logics were decomposed to Level 8 of the Work Breakdown Structure (WBS) where logic was detailed, scope was defined, detail durations and cost estimates prepared, and resource-loaded schedules developed. Technical Basis Review (TBR) packages were prepared which include this information and, in addition, defined the enabling assumptions for each task and the risks associated with performance. This process is discussed in Section 2.1.

Reviews of the subactivities within the Level 1 Logic TBRs were conducted to provide the recommended solution to the SST Interim Stabilization mission. Cost and schedule risk analyses were performed by members of the Lockheed Martin Hanford Corporation (LMHC) Business Management and Chief Financial Officer organization along with specialists in risk analysis from TRW, Inc. and Lockheed Martin Energy Systems. The process evaluated technical, schedule, and cost risk and produced a range of probabilities of success for cost and schedule. The results were modeled using a statistical analysis approach and are included in Section 4.0, Risk Analysis Results.

Important key assumptions of the Project Plan include the approval to co-mingle all liquid waste types (non-complex, complexed, and complexed transuranic) and to pump C-103 with the organic layer left in place.

The co-mingling of waste is within U.S. Department of Energy (DOE), Richland Operations Office's (RL), jurisdiction to approve. The pumping of tank C-103 with the organic layer in place will require the concurrence of the Washington State Department of Ecology (Ecology). There are other examples of DOE activities that affect this plan, such as the closure of the Organic Complexant Unreviewed Safety Question (USQ).

While this document provides evaluation of contractor activities, activities performed by DOE are not included. Durations have been assumed for DOE activities. However, for the overall plan to be viable to the success probabilities set forth in this document, the same level of estimating, scheduling, resource assignment, and risk assessment rigor should be applied to all program activities. It is assumed that the DOE activities will be separately evaluated.

An independent review of technical plans and processes was conducted utilizing personnel both from Fluor Daniel Hanford, Inc., (FDH), LMHC, DOE, and other Hanford contractors.

An analysis (Section 3.3 and 4.0) of the overall costs to prepare for and perform the SST Interim Stabilization work scope was completed. Based on the risk analysis, the revised cost to perform the work at an 80% probability of success is $145,397K. This cost is $19,366K more than the Project Plan. The SST Interim Stabilization Project details are summarized in Table 1-1.

Table 1-1. Risk Analysis Summary. ($000s)

	Project Plan	Risk Analysis	Required Net Change
FY 1998 Actuals - (Oct thru May) (Section 4.4)	4,670	4,670	0
Estimate to Complete (Project Plan) (Section 3.2)	111,763	111,763	0
Baseline Adjustments (Section 3.3)	0	12,926	12,926
Cost to Achieve Category I and II 80% Probability of Success (Section 4.2.2)	0	1,511	1,511
Risk Mitigation (Section 4.2.4)	0	3,526	3,526
Category III Risk Allowance (Section 4.2.4)	--	4,774	4,774
Escalation (Section 4.3)	9,598	6,227	(3,371)
Total Cost (Section 5.0)	126,031	145,397	19,366

An analysis (Section 4.5) was also performed of the overall schedule to complete the SST Interim Stabilization program. Table 1-2 summarizes the schedule analysis results.

Table 1-2. Schedule Risk Analysis Summary

Category I and II		Category I, II, and III	
Probability of Success	Date	Probability of Success	Date
0%	Sept. 30, 2004	0%	Sept. 30, 2004
80%	May 23, 2005	80%	June 13, 2005

The schedule analysis indicated that, in order to achieve an 80% probability of success, the project duration should be extended until June 2005.

The analysis is based on a statistical probabilistic approach. Pumping durations, as an example, have significant uncertainty due to the composition of the waste and the physics of the interstitial migration of liquid through the waste material. A plus/minus probability of 20% was utilized for this risk analysis.

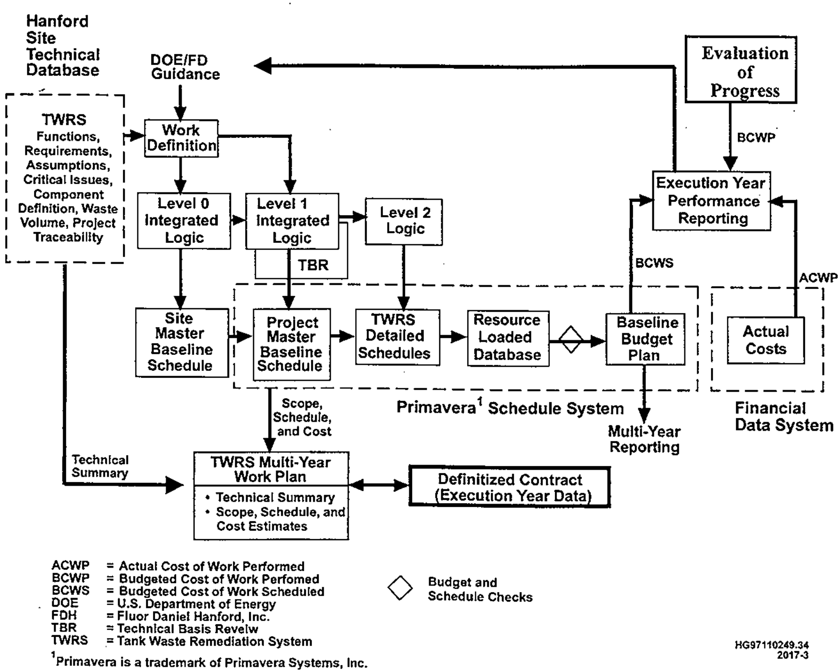
2.0 APPROACH

This section includes a discussion of the planning process, basis of estimate, and pricing validation, and risk analysis process employed in this document.

2.1 PLANNING PROCESS

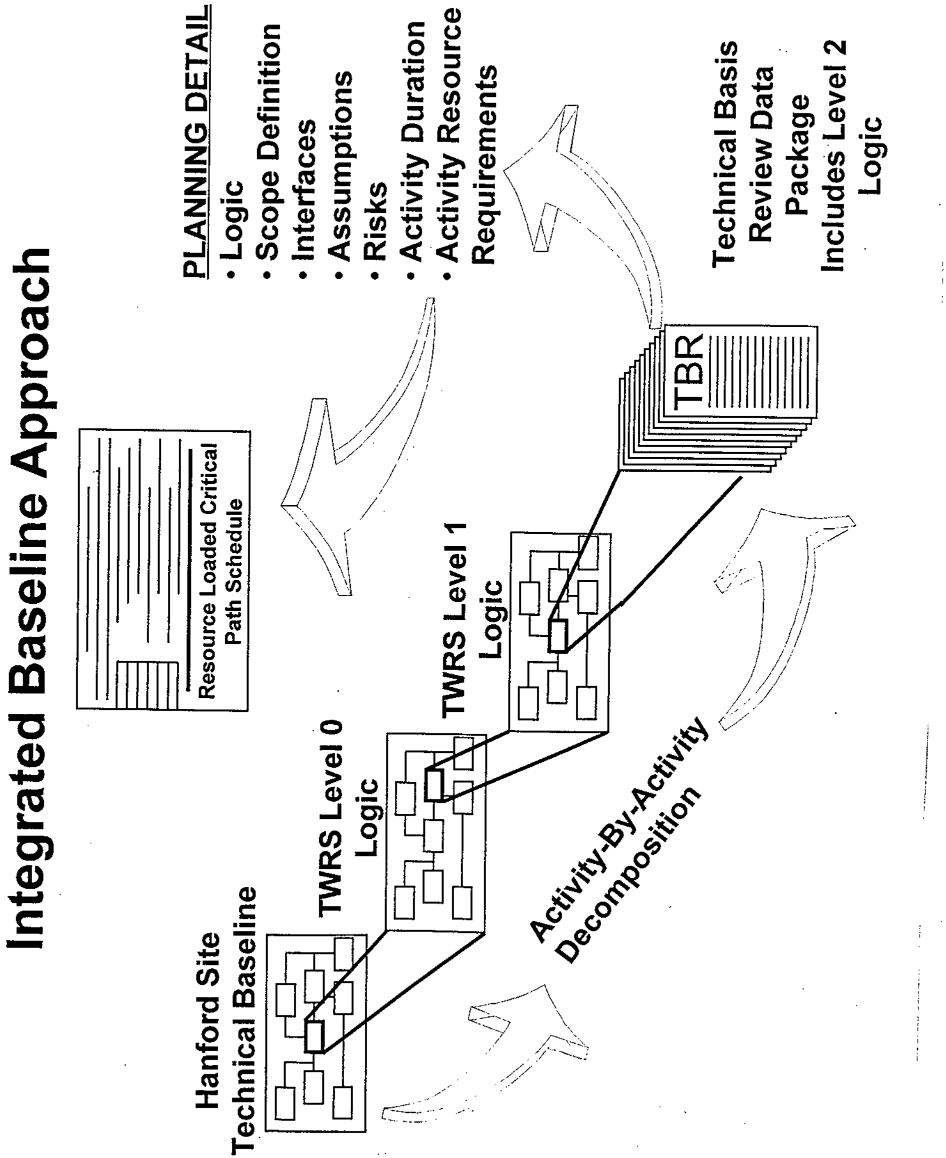
The LMHC Integrated Baseline Development model is shown in Figure 2-1. To prepare the SST Interim Stabilization baseline, the Integrated Baseline Approach was utilized which is further illustrated in Figure 2-2. This approach reflects a systems engineering management methodology of "top down" development of requirements and technical scope in order to define the logics, schedules, and costs necessary for project baseline and MYWP.

Figure 2-1. Integrated Baseline Development Model.



Multi-functional planning teams were formed with representatives from Operations; Characterization; SST Interim Stabilization; Nuclear Safety; Environmental Safety, Health and Quality Assurance (ESH&Q); Engineering; Maintenance; the Management and Integration Contractor (Fluor Daniel Hanford); Business Management (scheduling and cost estimating); and the Chief Financial Office. Team leads were assigned to the planning effort commensurate with the type of work being addressed. The purpose of these multi-functional planning teams is to streamline communication, planning, and integration between performing organizations.

Figure 2-2 Integrated Baseline Approach



The Project Hanford Management Contract (PHMC) team developed Level 0 Logic Diagrams as a tool for defining the work scope, and establishing direction of logical relationships and sequences of activities necessary to achieve the TWRS Mission (perform saltwell pumping and interim stabilization). The Level 1 Logics are a further breakdown of the activities from box number 23 (Perform Saltwell Pumping and Intrusion Prevention) of the Level 0 Logic, shown in Figure 2-3. The logic development integrates the technical requirements and mission and validates the need for the work. Initially, a project activities logic diagram, as shown in Figure 2-4, was developed that illustrates the typical activities (and the interrelationships) necessary to perform safe and compliant tank stabilization and isolation. This logic diagram includes reference activities, program-unique activities, and tank-unique activities. Using this project activities logic, as well as other technical and engineering data, tank-specific Level 1 logic diagrams were developed to fully define the scope of work for each of the 29 tanks listed in Table 2-1. Figure 2-5 is an example of a tank specific logic for tank S-102.

Table 2-1. SST Interim Stabilization Level 1 Logic Diagrams

Tank	Project Plan Figure #	Tank	Project Plan Figure #	Tank	Project Plan Figure #
A-101	E-1	S-109	E-11	T-110	E-21
AX-101	E-2	S-111	E-12	U-102	E-22
BY-105	E-3	S-112	E-13	U-103	E-23
BY-106	E-4	SX-101	E-14	U-105	E-24
C-103	E-5	SX-102	E-15	U-106	E-25
S-101	E-6	SX-103	E-16	U-107	E-26
S-102	E-7	SX-104	E-17	U-108	E-27
S-103	E-8	SX-105	E-18	U-109	E-28
S-106	E-9	SX-106	E-19	U-111	E-29
S-107	E-10	T-104	E-20		

Using the project WBS and activities identified on the Level 1 logic diagrams, TBR narratives were prepared to fully define and document the technical basis, assumptions, risks, and interfaces for each activity.

With the scope and activity defined by the Level 1 logic diagrams and TBR narratives, the planning teams broke down each of the activities and their logic to prepare the essential components for TBR packages. These components included the following:

- TBR (Level 1 logic activity) control logs
- TBR narratives
- Primavera Project Planner (P3)[1]-generated subactivity (task) logic networks
- Subactivity (task) cost estimating input sheets (CEIS)
- P3-generated resource and cost report.

[1]Primavera Project Planner is a trademark of Primavera Systems. Inc.

Figure 2-3. TWRS Level 0 Logic

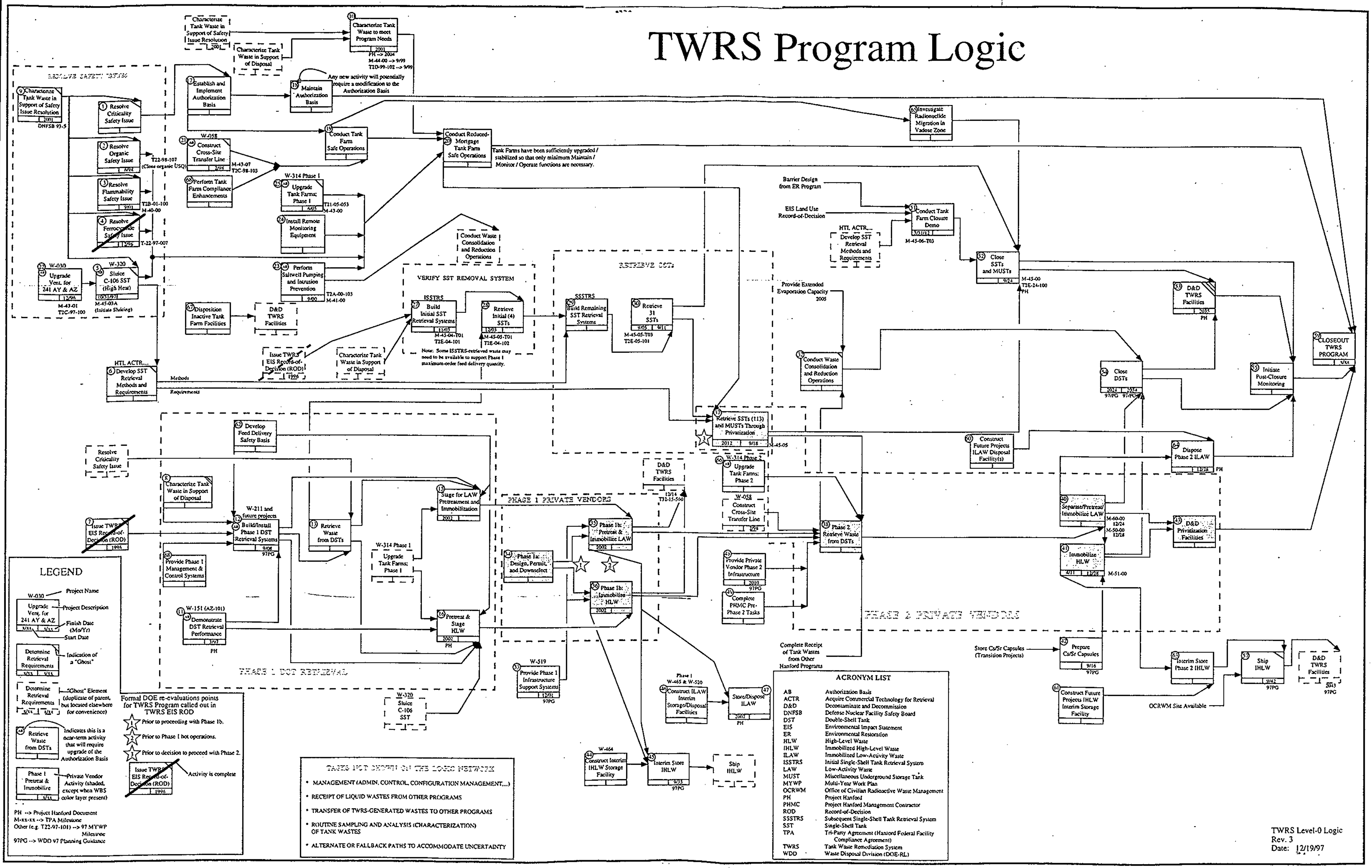


Figure 2-4. SST Interim Stabilization Level 1 Logic

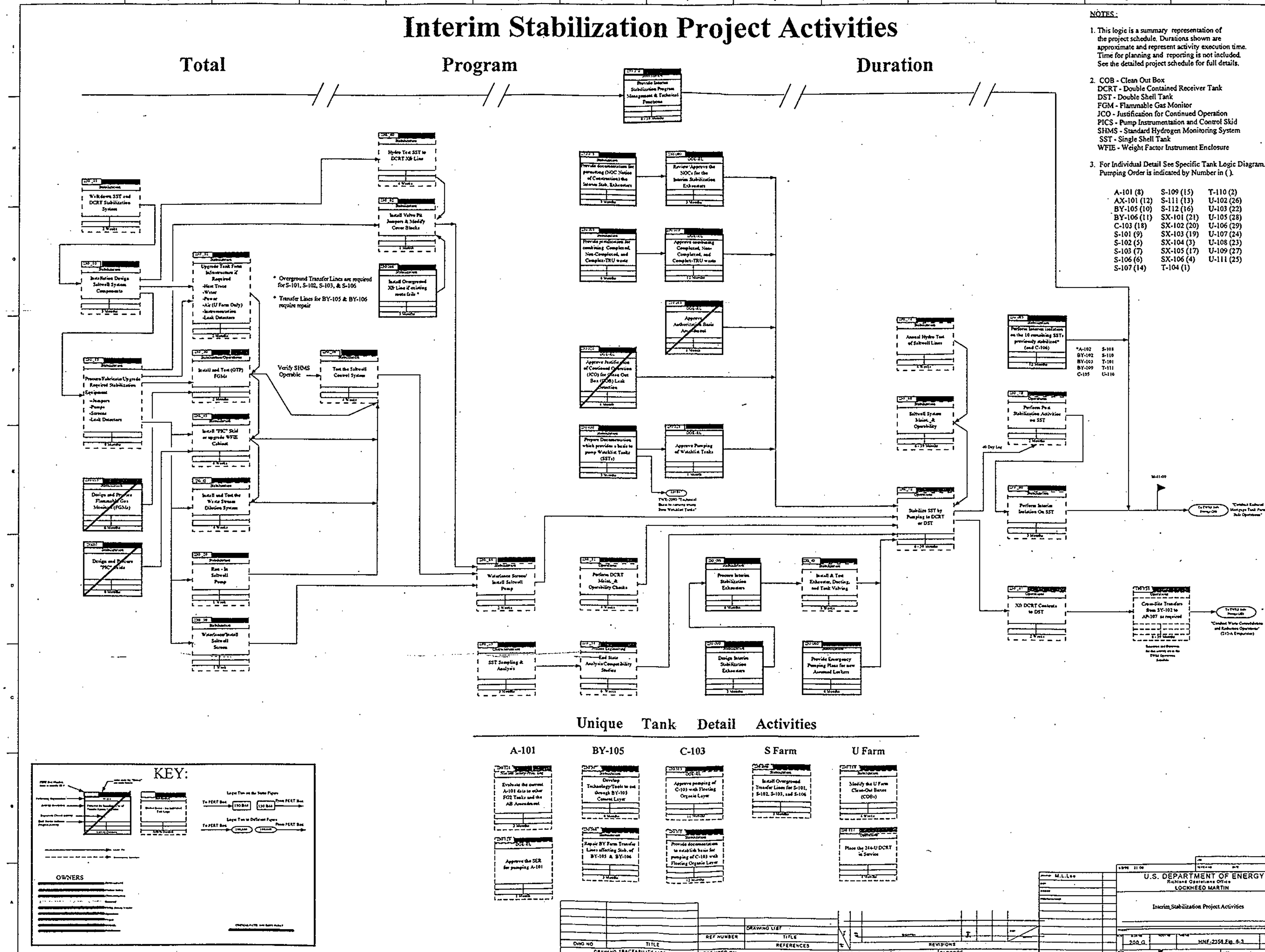
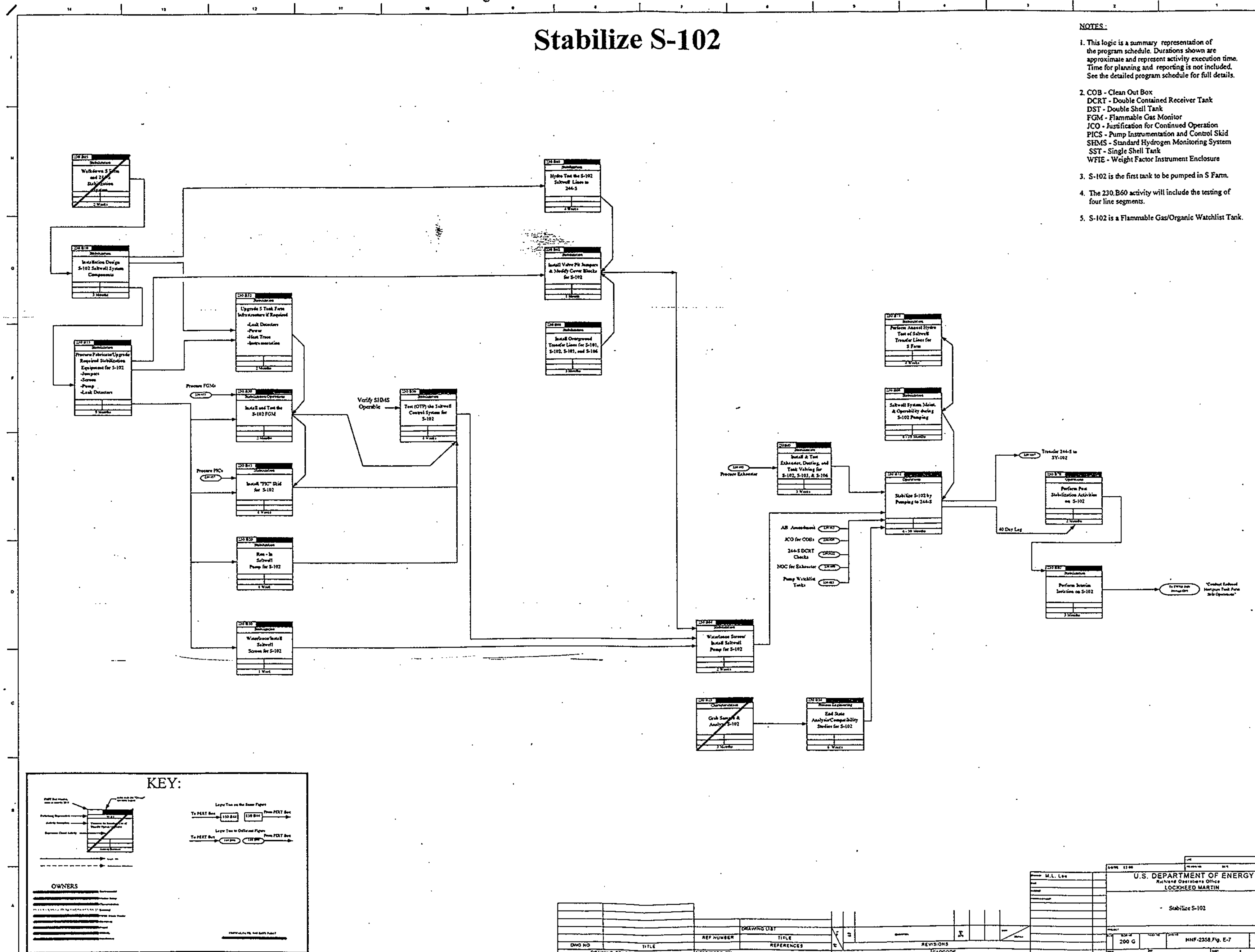


Figure 2-5. SST Interim Stabilization Tank Logic



This level of detail was necessary to adequately define and document the basis for the scope, schedule, and resource estimate at an executable task level. The subactivity (task) logic diagrams provide titles for the tasks, predecessor and successor activities, durations, and logic ties. The CEISs define the subactivity (task) scope, resources, basis of estimate, and assumptions.

The CEISs were prepared by the planning teams with the assistance of schedulers and cost estimators using desk instructions and guidelines. These completed estimates are activity based and represent a documented, traceable scope and basis for the estimate at the executable task level commensurate with the stage of the work and the level of scope definition available. The estimates are consistent with the *Hanford Cost Estimating and Scheduling Guide*, DOE/RL-97-90, Rev. 0.

Using the Level 1 logic diagrams, data from the TBR packages, and other information (as required), a detailed integrated schedule was developed in P3. This baseline schedule is task oriented, resource loaded, and logic driven. This schedule is traceable to the logic diagrams, WBS, activity owners (performing organizations), and TBR package data including the CEISs. Resources from the CEISs were loaded and priced in P3 to produce the base case cost and labor resources (full-time equivalent summaries for work defined in the Level 1 logic diagrams).

A systems-based approach was used to prepare the SST Interim Stabilization Project TBR data packages. TBR packages were assembled for activities shown on the project activities Level 1 logic diagram. These TBR packages became the "library" of data used to develop 29 tank "data files" for activities on the 29 tank-specific logic diagrams.

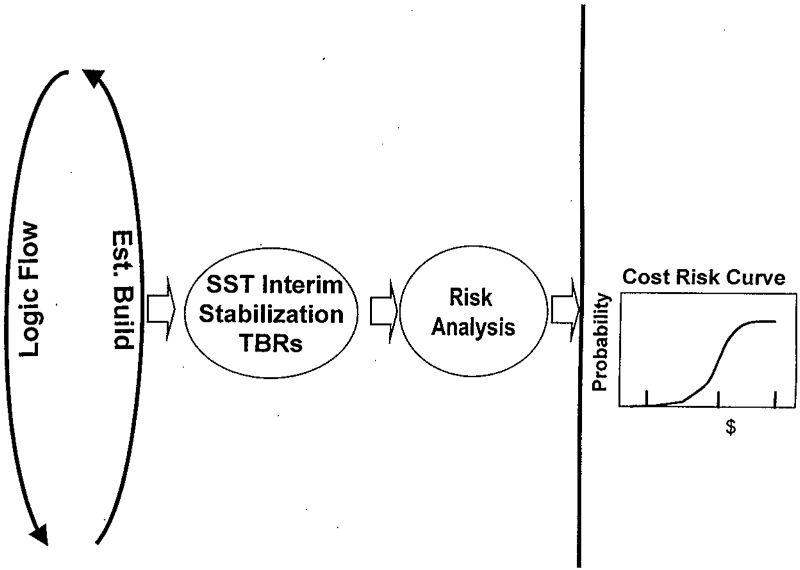
2.2 BASIS OF ESTIMATE

Figure 2-6, Cost Estimating Basis of Estimate, provides a summary of how the basis of estimate is developed and utilized in the logic/TBR/baseline development/risk analysis process. Bases of estimate for the activities documented in TBR packages are contained in the CEISs which were prepared according to written guidelines and instructions for the Project Plan baseline. Bases of estimate have been developed to the lowest level of detail practical (generally the executable task Level 2 of the logic and Level 8 of the WBS), commensurate with the stage of the project work and the level of scope definition available. The TBR package estimates have been prepared with integrated planning team support from cost estimators and schedulers. Resources were estimated using applicable historical experience and cost information from similar work as well as engineering and operations judgement.

Figure 2-6

Cost Estimating Basis of Estimate

- Range
  - Magnitude, preliminary, and definitive
- Process
  - Bottom up cost estimate
    - Pricing analysis factored for scope, enabling assumptions, risks
  - Lowest level of planning, systematic ties to program/project logic (Level 1 and 2) and scope activities detailed by duration, resources, and schedules
  - Consolidated through logic, WBS, and other program/project costs
- Results
  - Logic tied, resource loaded, scope, schedule, and cost framework



2.3 PRICING VALIDATION

2.3.1 Rates and Factors

The pricing of resources specified in the TBR package CEISs was accomplished in the P3 schedule using rates and factors approved by FDH and DOE, including standard labor rate tables, burdens, and pools and assessment factors. The rates and factors utilized were the FY 1999 forward pricing rates issued for preparation of the FY 1999 Multi-Year Work Plan (MYWP) in effect at the time the Project Plan was issued.

2.3.2 Third Party Reviews

The cost estimate prepared for the Project Plan baseline and documented in the TBR packages and schedule has been reviewed and approved by members of the multi-disciplined, integrated planning teams. These estimates are activity-based, and were prepared with the assistance of cost estimators. These estimates and associated schedules were used in the independent analysis of risk.

A review of the development, estimating, and analysis process was conducted by LMHC senior management. Comparisons were made to the techniques and rigor applied in development of fixed-price competitive projects. Lessons learned from analyzing other Lockheed Martin, DOE and U.S. Department of Defense projects were considered.

The Project Plan baseline has received third party review and revision by the integrated planning teams, senior management within LMHC, and by the PHMC team. The focus of these optimization reviews was to identify duplicate or missing activities, and to evaluate activities for soundness, logic flow and appropriate scheduling. In addition, the logic was crosswalked to the WBS to ensure that all scope was included and to analyze interfaces between performing organizations and programs.

2.3.3 Escalation Assumptions

Escalation has been applied to the project costs used in this risk analysis per the latest DOE and FDH guidance for FY 1999 MYWP forward pricing. The escalation factors are effective starting in FY 2000 as the base pricing rates are in constant FY 1999 dollars. The annual and cumulative escalation factors are shown in Table 2-2.

Table 2-2. Escalation Factors for Operating Expenses

Fiscal Year	Annual Rate	Cumulative Rate	Fiscal Year	Annual Rate	Cumulative Rate
2000	2.1%	2.1%	2003	2.2%	9.0%
2001	2.2 %	4.3%	2004	2.2%	11.4%
2002	2.2%	6.6%	2005	2.2%	13.8%

2.4 RISK ANALYSIS PROCESS

The purpose of this risk analysis is to quantitatively assess risk in order to support the management decision-making process. This risk analysis identifies required cost and schedule targets to provide an acceptable probability of success for the SST Interim Stabilization Project. The risk management process is shown in Figure 2-7.

Throughout Lockheed Martin Corporation, this type of risk analysis process is used in contractually committing to incentive based projects with performance milestones and fixed price contracts. In this case, the "probability of success" would typically translate to the probability of making profit or performance award fees. This process has served the corporation and its stockholders well for many years.

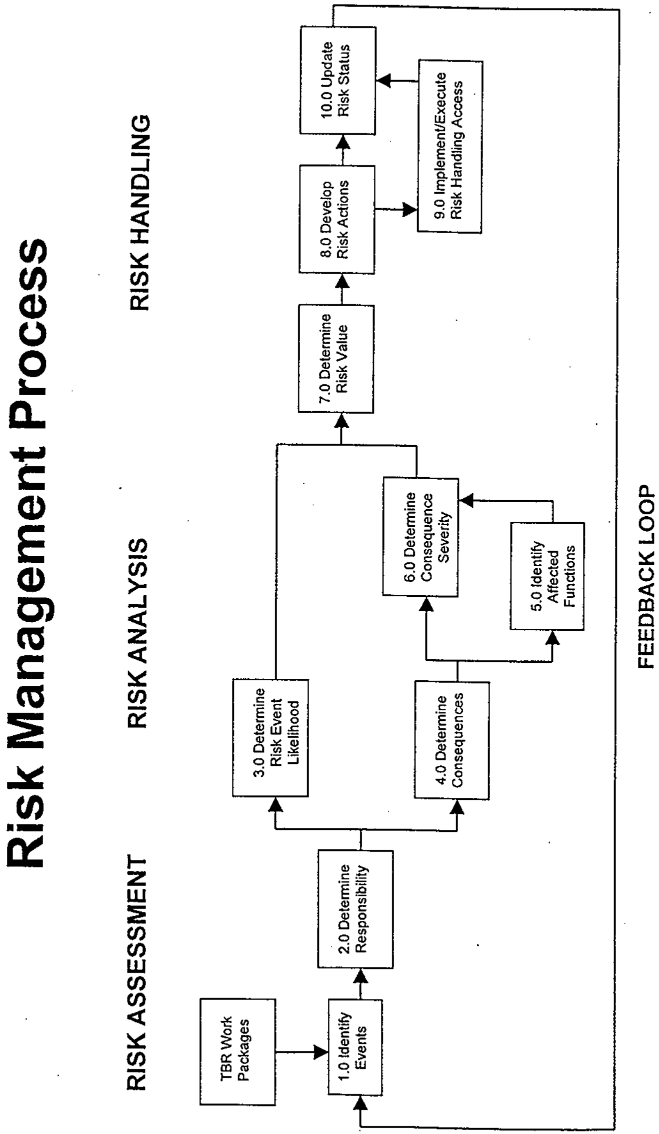
The statistical risk analyses produce "S curves," which present cost vs. probability of success (for a cost risk analysis), or desired program completion date vs. probability of meeting that completion date (for a schedule risk analysis). These curves can also be used to indicate additional cost and/or extra schedule time required to achieve a desired probability of program success (80% probability of success is frequently chosen as the target).

Each risk summary "S curve" developed is a cumulative representation of the probability distribution of success for a given program cost (in either dollars or calendar days). For a given point on the curve, the value on the horizontal axis identifies the cost (dollar value in millions or schedule in calendar days) required to assure the probability of success identified on the vertical axis.

The risk analysis process begins with a review of the scope of work and cost (time and money) defined by the TBR packages and associated detailed schedules. Costs are then categorized into one of four types:

- **Category I.** Project-Specific Fixed -- an event that is certain to occur or item that is certain to be required and cost or quantity is firmly known (e.g., monthly car payment).
- **Category II.** Project-Specific Variable -- an event that is certain to occur or item that is certain to be required and whose cost or quantity varies over some finite range (e.g., gasoline expenses).
- **Category III.** Integrated Program Risk -- an event that may or may not happen or item that could be required but may not occur; if such an event occurs, it carries a cost or schedule impact which varies over some finite range (e.g., tire blowout).
- **Category IV.** Showstopper Risk -- an event that is driven by a technical or program issue that has a very small probability of occurrence; but if such an event occurs, a significant cost or schedule impact results. Because of the nature of such a risk, it has such large impacts on the program and would cause such a large perturbation of plans, that it must be mitigated through another means such as insurance or indemnification (e.g., massive collision).

Figure 2-7. Risk Management Process



When project costs are categorized, TBR cost forms for Category I and II activities and risk analysis forms for Category III activities are completed. Examples of blank forms are in Appendix A. Technical leads, operations personnel, estimators, and others with knowledge of the TBR package contents discuss the technical aspects of the TBR, as well as incorporate range estimating techniques to bound the cost and schedule of the work, given the specific scope of work identified. Range data documented in the forms include likelihood (%) and consequence ($K or calendar days) for both the baseline cost and schedule in terms of minimum, most likely, and maximum.

This range data identifies the distribution of probable costs associated with each task. This information is loaded into both a cost and a schedule risk model upon which a Monte Carlo simulation is performed. The Monte Carlo method is a simple means of analyzing complex business decisions. This method estimates probabilities and expected cost by empirical sampling from probability processes or distributions.

Monte Carlo sampling involves the assignment of random numbers to specific inputs in proportion to their probability of occurrence, drawing a sequence of random numbers and tabulating the associated outcomes. In this manner, a number of trials or a sequence of outcomes is generated which can be used to estimate expected values or the probabilities of complex events.

Risk analysis is the application of the Monte Carlo method to assess the risk of a project by combining the probabilities for the several component factors into a probability distribution for different livels of overall cost.

The purpose of this simulation is to consider variation in calculating a probability of achieving success within the bounds of a given cost or schedule. A Monte Carlo simulation is used on "certain to occur" activities because their costs may vary due to the random nature of human performance, reliance on free market economy, weather, and other acts of nature, labor negotiations, etc.

This type of curve, known as an "S curve," is first developed for all the "certain to occur" (Category I and II) items. The curve is used to identify the probability of success of the current cost or schedule, assuming that all goes as planned.

During the interview process, participants are encouraged to think of actions or events that could occur within the limits of the work scope which would either decrease or increase the cost or schedule of the work to be performed in the TBR. Furthermore, participants are asked to identify any risks outside the defined scope of the TBRs that they believe are reasonable issues warranting further analysis. These items are usually added to the Category III list, which represents the total identified project risk, excluding Category IV.

Because Category III items may or may not occur, additional data describing the likelihood of occurrence is required. Like the Category I and II data, this information represents a distribution of probable values. These data are added to the model and a second curve is generated which includes Category I, II, and III data and represents the total cost and schedule.

Using this curve, the probability of success with the current cost or schedule can be identified, and the additional resources required to ensure a given success probability can be determined.

If the additional resource requirement is determined to be too great or the additional risk is too high, mitigation actions can be developed and implemented to reduce the amount of risk exposure. If such actions are used, the costs associated with them are added to the Category I and II data (because they are then "certain to occur"), and the risk in the Category III data is either reduced or removed, based upon the calculated effectiveness of the mitigation action.

It should be noted that these "S curves" are based upon statistical data. Such data provide information for an aggregate population, but are of very limited value if applied to a single item. For example, life insurance tables are used to determine the price of premiums for an individual. They are based upon a statistical life expectancy. However, this does not mean that any single policy holder will live until the expected age nor does it identify at what age the policy holder will die. In a similar manner, using this methodology the total cost associated with risk can be predicted, but an item-by-item list of which risks will and will not occur (or when they will occur) is not possible. In a similar fashion, mitigation actions can reduce the overall risk exposure, but because the risk may not occur, the mitigation action costs may have been spent unnecessarily.

3.0 BASELINE ANALYSIS

This section includes a discussion of assumptions, baseline description, and proposed cost and schedule adjustments recommended to support the Project Plan.

3.1 KEY ASSUMPTIONS, ENABLING ASSUMPTIONS, AND CATEGORY IV RISKS

The total Project Plan effort is $111,763K (unescalated). This estimate includes the total costs to complete the project including costs for (1) stabilization activities, i.e., pumping; (2) characterization activities for sampling and laboratory analysis; (3) ESH&Q for permitting and environmental needs; and (4) Authorization Basis support, as required.

The costs of cross-site transfers and evaporator campaigns that support SST Interim Stabilization are not included in this estimate.

To avoid confusion, the distinction between key assumptions and enabling assumptions needs to be addressed. Key assumptions are those which define the bounds of the project scope. Enabling assumptions are those assumptions made because a decision is pending. The enabling assumptions allow development of a cost or schedule input; however, each enabling assumption carries with it the risk that the assumption is incorrect.

Several enabling assumptions were utilized in the development of the SST Interim Stabilization logics, as contained in the Project Plan.

The Risk Analysis on the Project Plan includes key assumptions that have been identified in order to bound the risk analysis. The key assumptions include critical risks that were not quantified due to the nature of the risk. These assumptions are deemed to be Category IV risks. Category IV risks are items that will require reevaluation of the project baselines if any of the events occur.

Category IV risks that were not quantified were identified to be key assumptions that would need to be managed at a programmatic level. The risks that were not included in the risk analysis curves along with a short explanation of each follow.

- **Equipment Procurement (STA-2).** The key assumption that major equipment will be procured and fabricated offsite supports successful completion of the Project within the cost and schedule contained in this analysis. The potential impacts associated with equipment fabrication onsite (less predictable costs and ability to meet delivery dates) cannot be quantified due to historical uncertainties related to these work assignments.

- **Hot Water Dilution Systems (STA-3).** Currently there are seven tanks that require a dilution system prior to pumping. There is a possibility that even with the installation of a dilution system that these tanks may not be pumpable due to line pluggage from solids precipitation. The waste in these tanks would either need to be stabilized using an alternative pumping technology or a means to stabilize the waste, a technical justification developed to defer interim stabilization until retrieval, or a means to stabilize the waste (i.e., eliminate liquids or doubly contain liquids) without pumping.

- **Operator Turnover (STA-4).** A greater than 25% turnover rate of operators is not accounted for in this analysis. If turnover exceeds 25%, the contractor will need to negotiate to maintain trained personnel and experience incurred costs to hold staff until staff qualification is complete. While this is not anticipated, major increases or decreases of other Hanford work scopes could cause such an event.

- **Labor disruption (STA-16).** This item was not considered in this analysis. A labor disruption is deemed highly unlikely and a cost value could not be determined on the risk.

- **222-S Analytical Laboratory will be available (STA-19).** This risk is a programmatic type risk that will require a contract modification or memorandum of understanding to ensure the timeliness of laboratory use and to ensure immediate notification of potential closures. Potential closure of the laboratory affects TWRS as a whole, not only the SST Interim Stabilization Project.

- **Co-Mingling of the Waste (STA-26).** This activity is the base assumption for the Project Plan. There is a risk that co-mingling will not be allowed. Renegotiation would be required due to the fact that the intent of the Project Plan was based on that assumption.

The following two items were determined to be external to the project's scope; however, they are within the overall TWRS program scope. They are listed as critical project risks but will be mitigated by overall program management.

- **Program Interfaces (STA-17) (STA-15).** Internal TWRS programs will not impact stabilization schedules. This item is a managerial decision-making issue. In the case where physical interference is identified with another program (e.g., Retrieval) or construction project (e.g., W-320), prioritization by LMHC will be required to reduce or eliminate this risk item. There is no schedule or cost item that could eliminate this issue.

- **End State Analysis (STA-20).** The resolution of the outstanding organic Unreviewed Safety Questions (USQ) is not included in the analysis because personnel appear to be adequately addressing this item. The USQ Closure seems to be imminent at this time.

3.2 BASELINE DESCRIPTION

Table 3-1 summarizes the Project Plan unescalated cost by fiscal year which were projected to complete the remainder of the SST Interim Stabilization scope of work defined in the detailed P3 schedule from June 1, 1998, through September 30, 2004. FY 1998 actuals through June 1, 1998, are discussed in Section 4.4. The costs in Tables 3-2 are a WBS breakdown of Table 3-1 and are supported by the TBR package data including the CEIS estimates used to resource load the activities in the schedule.

Table 3-1. SST Interim Stabilization Project Base Case Cost by Fiscal Year ($000s)

Description	1998	1999	2000	2001	2002	2003	2004	Total
Project Plan Costs	8,132	18,829	18,347	19,707	18,579	17,028	11,141	111,763

Table 3-2. Project Plan Cost by WBS (Unescalated)

RL WBS	RL WBS TITLE	TOTAL	FY 1998	FY 1999	FY 2000	FY 2001	FY	FY 2003	FY 2004
1.01.02.01.04.39.01	SST Process Engineering Studies	398	13	2	269	114			
1.01.02.01.04.39.02	Baseline/Financial Control	1160	289	171	176	210	193	62	59
1.01.02.01.04.39.03	Project Management	16,143	1,068	4,334	2,766	2,472	2,285	1,733	1,485
1.01.02.01.04.39.04	Regulatory/Environmental Compliance	8,527	894	1,660	1,702	1,466	1,316	754	735
1.01.02.01.04.39.05	SST Stabilization Capital Equipment	1,806	597	1,208					
1.01.02.01.04.39.06	Maintain SST Emergency Pumping Capability	538	75	137	109	109	109		
1.01.02.01.04.39.07	Overground Transfer Lines	200		200					
1.01.02.01.04.40.01	Stabilize and Isolate Tank A-101	1,240	46	482	182	182	121	9	218
1.01.02.01.04.40.02	Stabilize and Isolate Tank A-102	214						210	4
1.01.02.01.04.40.20	Tank Ventilation Sys 241-A Tank Farm	38		38					
1.01.02.01.04.40.40	241-A Tank Farm Annual Hydro	200		65	67	67			
1.01.02.01.04.41.01	Stabilize and Isolate Tank AX-101	1,419	147	529	209	230	77	9	218
1.01.02.01.04.41.20	Tank Ventilation Sys 241-AX Tank Farm	38		38					
1.01.02.01.04.41.40	241-AX Tank Farm Annual Hydro	268		65	202				
1.01.02.01.04.43.03	Stabilize and Isolate Tank BY-103	428						420	8
1.01.02.01.04.43.05	Stabilize and Isolate Tank BY-105	2,263	201	1,437	316	82		9	218
1.01.02.01.04.43.06	Stabilize and Isolate Tank BY-106	1463		727	272	238		9	218
1.01.02.01.04.43.09	Stabilize and Isolate Tank BY-109	214						210	4
1.01.02.01.04.43.20	Tank Ventilation Sys 241-BY Tank Farm	38		38					
1.01.02.01.04.43.30	DCRT 244-BX for SST 241-BY Tank Farm	313			167	146			
1.01.02.01.04.44.03	Stabilize and Isolate Tank C-103	1,802				1,239	336	9	218
1.01.02.01.04.44.05	Stabilize and Isolate Tank C-105	214						210	4
1.01.02.01.04.44.06	Stabilize and Isolate Tank C-106	214						210	4
1.01.02.01.04.44.20	Tank Ventilation Sys 241-C Tank Farm	39				39			
1.01.02.01.04.45.01	Stabilize and Isolate Tank S-101	1.443		716	500			9	218
1.01.02.01.04.45.02	Stabilize and Isolate Tank S-102	2,734	1,200	1,075	232			9	218
1.01.02.01.04.45.03	Stabilize and Isolate Tank S-103	1,749	293	1,188	40			9	218
1.01.02.01.04.45.06	Stabilize and Isolate Tank S-106	1,482	401	579	275			9	218
1.01.02.01.04.45.07	Stabilize and Isolate Tank S-107	1,243			586	431		9	218
1.01.02.01.04.45.08	Stabilize and Isolate Tank S-108	214						210	4
1.01.02.01.04.45.09	Stabilize and Isolate Tank S-109	1.725			1,071	427		9	218

Table 3-2. Project Plan Cost by WBS (Unescalated)

RL WBS	RL WBS TITLE	TOTAL	FY 1998	FY 1999	FY 2000	FY 2001	FY	FY 2003	FY 2004
1.01.02.01.04.45.11	Stabilize and Isolate Tank S-111	1,578			881	376	94	9	218
1.01.02.01.04.45.12	Stabilize and Isolate Tank S-112	1,770			1,035	507	2	9	218
1.01.02.01.04.45.20	Tank Ventilation Sys 241-S Tank Farm	153	38	38	78				
1.01.02.01.04.45.30	DCRT 244-S for SST 241-S Tank Farm	2,306	128	378	389	516	511	382	
1.01.02.01.04.45.40	241-S Tank Farm Annual Hydro	607			202	405			
1.01.02.01.04.46.01	Stabilize and Isolate Tank SX-101	1865				497	961	189	218
1.01.02.01.04.46.02	Stabilize and Isolate Tank SX-102	2,033				1,382	247	187	218
1.01.02.01.04.46.03	Stabilize and Isolate Tank SX-103	1,574				950	227	180	218
1.01.02.01.04.46.04	Stabilize and Isolate Tank SX-104	798	117	345	110			9	218
1.01.02.01.04.46.05	Stabilize and Isolate Tank SX-105	1,941			317	1,084	201	121	218
1.01.02.01.04.46.06	Stabilize and Isolate Tank SX-106	1,892	1,227	278	160			9	218
1.01.02.01.04.46.40	241-SX Tank Farm Annual Hydro	955		196	557	135	67		
1.01.02.01.04.47.01	Stabilize and Isolate Tank T-101	214						210	4
1.01.02.01.04.47.04	Stabilize and Isolate Tank T-104	446	147	73				9	218
1.01.02.01.04.47.10	Stabilize and Isolate Tank T-110	617	316	74				9	218
1.01.02.01.04.47.11	Stabilize and Isolate Tank T-111	214						210	4
1.01.02.01.04.47.30	DCRT 244-TX for SST 241-T Tank Farm	128	87	42					
1.01.02.01.04.48.02	Stabilize and Isolate Tank U-102	1,561					726	575	260
1.01.02.01.04.48.03	Stabilize and Isolate Tank U-103	2,529				567	1,331	388	244
1.01.02.01.04.48.05	Stabilize and Isolate Tank U-105	1,599					658	544	398
1.01.02.01.04.48.06	Stabilize and Isolate Tank U-106	1,606						967	638
1.01.02.01.04.48.07	Stabilize and Isolate Tank U-107	1,415					791	377	247
1.01.02.01.04.48.08	Stabilize and Isolate Tank U-108	1,900				188	1086	407	218
1.01.02.01.04.48.09	Stabilize and Isolate Tank U-109	1,677					785	488	404
1.01.02.01.04.48.10	Stabilize and Isolate Tank U-110	214						210	4
1.01.02.01.04.48.11	Stabilize and Isolate Tank U-111	2,162					1,428	517	218
1.01.02.01.04.48.20	Tank Ventilation Sys 241-U Tank Farm	116					116		
1.01.02.01.04.48.30	DCRT 244-U for SST 241-U Tank Farm	1,836				460	202	743	431
1.01.02.01.04.48.40	241-U Tank Farm Annual Hydro	270						270	
1.01.02.01.04.72.01	Pumping for Remaining SST's (29)	25,801	847	2,714	5,471	5,190	4,707	5,686	1,186
	REPORT TOTAL	111,763	8,132	18,829	18,347	19,707	18,579	17,028	11,141

3.3 BASELINE COST ADJUSTMENTS

The required cost baseline adjustments identified during the risk analysis are shown in Table 3-3 and are additional scope items that need to be added to the Project Plan baseline. These adjustments are not risk-related items, they are scope omissions of the Project Plan.

Table 3-3. Required Cost Baseline Adjustments ($000s, unescalated)

Description	1998	1999	2000	2001	2002	2003	2004	2005	Subtotal
Baseline in the Project Plan (Section 3.2)	8,132	18,829	18,347	19,707	18,579	17,028	11,141	0	111,763
Additional Sampling Activities ("Two Year" Rule)	0	1,100	235	881	145	0	0	0	2,361
Run-In Saltwell Pump A-101	0	0	10	0	0	0	0	0	10
Technology Evaluation	0	250	150	100	0	0	0	0	500
Evaluation of Waste Co-mingling related to the vitrification process	0	150	150	200	0	0	0	0	500
Engineering study to Evaluate utilization of larger saltwell screen	0	32	0	0	0	0	0	0	32
Engineering Study to Evaluate pumping directly to SY-102	0	57	0	0	0	0	0	0	57
BY-105 Authorization Basis Amendment		33							33
C-103 Overground Transfer Line			1,200						1,200
C-103 Organic Layer Removal		914	2,132	762					3,808
Study Transfer for 244-U DCRT				65					65
Expand RAM Analysis		78							78
Heat Trace Failure Study		35							35
Applicability of New Unplugging Tools		75							75
Upgrade 204-AR/Field Loading Capabilities		33	99						132
Additional NOC for C-103			40						40
Incremental Overtime for Emergency Pumping		50	50	50	50				200
Additional cost for revised pumping durations (including schedule extension)	0	0	0	0	0	0	1,200	2,600	3,800
Subtotal - Required Cost Baseline Adjustments	**0**	**2,807**	**4,066**	**2,058**	**195**	**0**	**1,200**	**2,600**	**12,926**
Total, Project Plan, Rev. 1, with adjustments	8,132	21,636	22,413	21,765	18,774	17,028	12,341	2,600	124,689

A description of each item follows:

- **Additional Sampling Activities.** The cost for additional tank sampling and analysis is to comply with the Double-Shell Tank Waste Analysis Plan ("Two Year" Rule). ($2,361K)

- **A-101 Saltwell Pump.** The additional costs for the A-101 saltwell pump run-in were not included in the Project Plan. ($10K)

- **Technology Evaluation.** $500K is included to evaluate and determine if there are better technologies to perform the work or resolve technical issues. Costs to develop new technologies are not included in the baseline.

- **Evaluation of Waste Co-mingling (related to the vitrification process).** The costs for evaluation of waste co-mingling ($500K) related to the vitrification process is to ensure that critical parameters of the Waste Form Specification are not placed at risk from co-mingling of the waste streams.

- **Engineering Study - Utilization of Larger Saltwell Screen.** The costs of the engineering study to evaluate the utilization of a larger diameter saltwell screen ($32K) supplements partial cost in the baseline.

- **Engineering Study - Pump Directly to SY-102.** The costs of the engineering study to evaluate pumping directly to SY-102 ($57K) supplements partial cost in the baseline.

- **BY-105 Authorization Basis Amendment.** $33K is included to adjust the baseline estimate to support an Authorization Basis change for technology changes to cut through the cement layer in BY-105.

- **C-103 Overground Transfer Line.** $1,200K will provide for a new overground transfer line from C-103 to AN-101. This line will allow a bypass of the 244-CR DCRT.

- **C-103 Organic Layer Removal.** This activity includes the workscope to remove the organic layer from C-103. This item will add $3,808K to the baseline.

- **Study 244-U DCRT Transfer.** This activity supports evaluating pumping directly to SY-102. This study includes $65K for evaluations and options for transfer through the 244-U DCRT.

- **Expanded RAM Analysis.** $78K will be needed to expand the RAM analysis to evaluate all saltwell systems including pumps, DCRTs, supporting transfer systems, etc.

- **Heat Trace Failure Study.** Evaluate means of automatically detecting heat trace failures to prevent plugging lines during transfer. ($35K)

- **Applicability of New Industrial Tools.** This activity will include the evaluation of applications at Hanford for unplugging tools and other industrial tools that could support saltwell pumping. ($75K)
- **Upgrade 204-AR/Field Loading Capabilities.** This activity will support the 204-AR facility to be a high volume transfer facility and support the LR-56 field loading capabilities determination in order to bypass DCRTs. ($132K)

- **Additional NOC for C-103.** This activity was identified by environmental and determined to be an adjustment to the Project Plan. ($40K)

- **Incremental Overtime for Emergency Pumping.** This activity is to support emergency pumping of a newly identified leaking tank. This is to cover overtime so as to not shut down other pumping tanks to support the new leaker. ($200K)

- **Revised Pumping Durations.** The costs for additional pumping durations ($3,800K) are due to correcting a non-conservative pumping duration that was utilized in the Project Plan. While performing the risk analysis, it was determined that the historical method for determining pumping durations contained an error and the resulting correction changed each tank's pumping duration. Table 3-4 in Section 3.4 compares the Project Plan pumping durations to the revised pumping durations. The revised pumping durations extend the project completion date from September 2004 to March 2005.

The fiscal year phasing of the required cost baseline adjustments was derived from a schedule assessment to determine when the activities are required. As previously mentioned, the Project Plan completion date of September 2004 was extended resulting in additional costs in FY 2005.

The total value for Required Cost Baseline Adjustments ($12,926K) represents 11.6% of the Project Plan estimate of $111,763 for remaining work. Because the Project Plan estimate contains no contingency for "known unknowns," it is recommended that a contingency be established before signing consent decrees.

3.4 BASELINE SCHEDULE ADJUSTMENTS

Subsequent to issuance of the Project Plan, a review was conducted of the pumping duration calculation methodology as discussed in HNF-2978 resulted in increases in most estimated pumping durations as seen in Table 3-4. These increases were based on various "first principles" considerations related to waste composition and tank configuration. In addition, for risk analysis purposes, another correction was made to the estimated tank pumping durations to account for the requirement that the DCRTs be periodically emptied as part of the saltwell pumping activities. It was assumed that DCRT emptying will require SST pumping to be halted.

Table 3-4. Tank Pumping Duration

Tank	Project Plan Duration	Recalculated Duration w/DCRT	Delta (days)
A-101	1003	999	-4
AX-101	793	769	-24
BY-105	458	523	+65
BY-106	639	645	+6
C-103	88	115	+27
S-101	303	436	+133
S-102	608	687	+79
S-103	212	304	+92
S-106	519	644	+125
S-107	211	312	+101
S-109	427	509	+82
S-111	486	646	+160
S-112	334	428	+94
SX-101	395	505	+110
SX-102	548	665	+117

Tank	Project Plan Duration	Recalculated Duration w/DCRT	Delta (days)
SX-103	654	831	+177
SX-104	609	716	+107
SX-105	729	919	+190
SX-106	586	649	+63
T-104	183	210	+27
T-110	153	232	+79
U-102	334	474	+140
U-103	487	633	+146
U-105	426	546	+120
U-106	153	267	+114
U-107	395	533	+138
U-108	455	629	+174
U-109	426	616	+190
U-111	304	428	+124

In the Project Plan schedule, U-105 was the controlling tank, resulting in a project completion of September 28, 2004, while Tank U-109 was scheduled to be complete on August 20, 2004. Using the revised durations, the pumping time for U-105 increases by a total of 120 days (40 days based on HNF-2978, Rev. 1, and 80 days for the DCRT correction). The pumping time for U-109 increases a total of 190 days (100 days based on HNF-2978, Rev. 1, and 90 days for the DCRT correction). U-109 then becomes the controlling tank, and the program completion date becomes March 4, 2005. (U-105 thus completes isolation on January 28, 2005).

This information is summarized in the table below:

Table 3-5. Tanks U-105 and U-109 Revised Pumping Completion Dates

Tank	Project Plan Completion Date	Increase in Pumping Durations (days)		New Completion Date
		HNF-2978	DCRT	
U-105	September 28, 2004	+40	+80	January 28, 2005
U-109	August 20, 2004	+100	+90	March 4, 2005

The risk analysis described in this document is based on the schedule incorporating these revised pumping durations. This schedule represents a change to the SST Interim Stabilization baseline.

4.0 RISK ANALYSIS RESULTS

4.1 INTRODUCTION

The cost and schedule Monte Carlo risk analyses were performed as described in Section 2.4 above. The Monte Carlo risk analyses produce "S curves," which present cost vs. probability of program success (for a cost risk analysis), or desired program completion date vs. probability of meeting that completion date (for a schedule risk analysis). These curves can also be used to indicate additional cost and/or extra schedule time required to achieve a desired probability of program success (80% probability of success is frequently chosen as the target).

4.2 COST RISK ANALYSIS

This section discusses the cost risk analysis with impacts to the Project Plan baseline before and after risk mitigation to achieve an 80% probability of success.

4.2.1 Mitigations Costed Within The Project Plan

A number of activities were included in the Project Plan baseline costs ($111,763K) to mitigate known risks. These activities are shown on Table 4-1. The costs for these activities were not analyzed from a cost/benefit risk perspective but simply represented the "hand-off" starting point for initiation of this risk analysis. Residual risks related to these activities were analyzed, if required, and are addressed in the Category I, II, and III curves and related data that follow. Time phasing of costs for activities in Table 4-1 is embedded in the cost profile for the $111,763K baseline.

Table 4-1. Mitigation Activities Included in Project Plan Cost Baseline ($000, unescalated)

Mitigation Activities	Cost Baseline	Risk #
Plan and allocate separate resources to support readiness for emergency pumping of one unspecified "leaking" tank per year.	539	STA-1
Evaluate larger diameter saltwell screen to allow more drainage to better understand pumping durations.	18	STA-6
Develop strategy early in the project to remove C-103 organic layer with the supernate.	7.8	STA-7
Develop new technology to install saltwell screen in tank BY-105 which has a concrete surface	750	STA-8
Perform studies, facility modifications, and update the Basis for Interim Operation (BIO) to allow numerous tanks to be pumped into a double-contained receiver tank (DCRT) simultaneously without having dangerous flammable gas accumulations	249	STA-9
Conduct studies to determine appropriate instrumentation and control (I&C) to meet saltwell pumping schedule and evaluate BIO modification for material balance controls	46	STA-24
Perform Reliability, Availability, and Maintainability (RAM) analysis to recommend I&C modifications to minimize master component shut down interlocks	122	STA-12
Design and install dilution system for approximately seven tanks that have a high risk of having transfer lines plug while saltwell pumping; and perform solution prediction temperature loss evaluation for each tank	1,854	STA-13
Evaluate pumping S and SX farms directly to SY-102, bypassing 244-S DCRT.	8	STA-18
Perform compatibility assessments to allow pumping multiple tanks simultaneously to ensure that the tanks' chemical makeups do not react adversely. This includes co-mingling of complexed and non-complexed wastes.	174	STA-23
Perform training for the Operations personnel to cover the possible 25% turnover due to downsizing on the Hanford site.	1,539	STA-4
Total	**5,308**	

4.2.2 Category I and II

The curve shown in Figure 4-1 reflects the Category I and II costs contained in the Project Plan baseline with the required cost baseline adjustments discussed in Section 3.3. This curve reflects a 62% probability of success at a total program cost of $124,689K. To achieve a recommended 80% probability of success for the Category I and II costs, the curve indicates that an additional $1,511K be added to the baseline. Table 4-2 shows the annual breakdown of these costs.

Figure 4-1. Category I and II for Cost

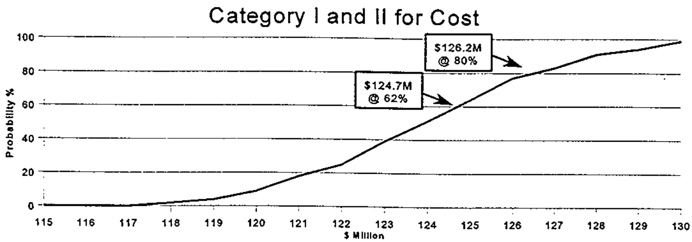


Table 4-2. Costs to Achieve 80% Probability of Success (Categories I and II) ($000s, unescalated)

Description	1998	1999	2000	2001	2002	2003	2004	2005	Total
Project Plan (Section 3.2)	8,132	18,829	18,347	19,707	18,579	17,028	11,141	0	111,763
Required Cost Baseline Adjustment (Section 3.3)	0	2,807	4,066	2,058	195	0	1,200	2,600	12,926
Subtotal	8,132	21,636	22,413	21,765	18,774	17,028	12,341	2,600	124,689
Cost to Achieve 80% Probability of Success	0	280	291	282	243	221	160	34	1,511
Total	**8,132**	**21,916**	**22,704**	**22,047**	**19,017**	**17,249**	**12,501**	**2,634**	**126,200**

The $1,511K is derived from the data model cost curve at the 80% probability of success point for Categories I and II. These dollars are time-phased by fiscal year based on a percentage of the recommended cost for the period FY 1999 through FY 2005.

4.2.3 Category III Unmitigated Risk

The curve shown in Figure 4-2 reflects the curve shown in Figure 4-1 (including Project Plan Required Baseline Adjustments and Cost to Achieve 80% Probability of Success for

Categories I and II) with the addition of unmitigated Category III risks. The curve in Figure 4-2 shows that $144,500K is required to achieve an 80% probability of success. Comparing the two curves at 80% probability of success indicates the likely cost of the unmitigated Category III risk is $18,300K above the costs shown in Table 4-2 (Required Cost to Achieve 80% Probability of Success). This $18,300K is shown in Table 4-3.

Figure 4-2. Category I, II, and III for Cost (Unmitigated Risk)

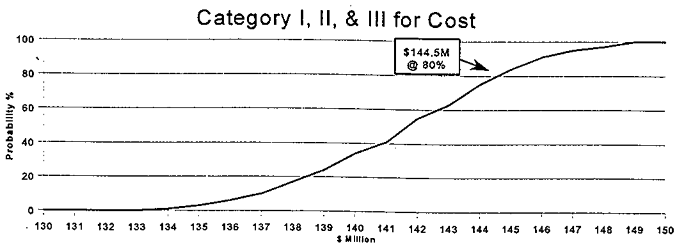


Table 4-3. Required Cost for Category III Unmitigated Risk ($000s, unescalated)

Description	1998	1999	2000	2001	2002	2003	2004	2005	Total
Project Plan, Rev. 1 (Section 3.2)	8,132	18,829	18,347	19,707	18,579	17,028	11,141	0	111,763
Required Cost Baseline Adjustment (Section 3.3)	0	2,807	4,066	2,058	195	0	1,200	2,600	12,926
Cost to Achieve 80% Probability of Success for Category I and II (Section 4.2.2)	0	280	291	282	243	221	160	34	1,511
Subtotal	8,132	21,915	22,704	22,047	19,017	17,249	12,501	2,634	126,200
Category III Unmitigated Risk		**3,397**	**3,519**	**3,417**	**2,948**	**2,673**	**1,938**	**408**	**18,300**
Total	8,132	25,313	26,223	25.464	21,965	19,922	14,439	3,042	144,500

The costs have been time phased by fiscal year based on a percentage of each fiscal year cost to the total.

Table 4-4 describes the Category III risk items representing the $18.3M of risk exposure.

Table 4-4. Critical Risk List Categorization

Risk #	Activity	Category	Risk #	Activity	Category
STA-1	A second tank within a year will start to leak.	Cost	STA-14	The cross site transfer line is not usable due to a pump failure in SY-102.	Schedule + Cost
STA-5	A management assessment will not be sufficient and a Readiness Assessment will be required.	Schedule + Cost * (DOE Activity/ Decision)	STA-18	Critical component fails on DCRT.	Schedule + Cost
STA-6	The pumping durations may extend.	Schedule + Cost	STA-22	Will not be able to ventilate C-103 without extensive modifications to the portable exhauster.	Schedule + Cost
STA-8	The risk for BY-105 is two-fold. One is that technology developed is not successful to cut through concrete layer. Two, work within this tank will require a change to the existing Authorization Basis.	Schedule + Cost* (Partial DOE Activity/Decision)	STA-23	Number of tanks pumped simultaneously will be limited by compatibility issues.	Schedule + Cost
STA-11	The increase in the Potential to Emit (PTE) for the SX Farm exhauster during Interim Stabilization will require renegotiation with Washington State Department Of Health (WDOH) and may drive the classification to a major stack.	Schedule + Cost	STA-24	Potential for Operational Safety Requirements (OSR) violation increases due to multiple tanks requiring 2-hr mass balance check.	Cost
STA-12	Complexity of control systems results in large number of equipment shutdowns (trips).	Schedule + Cost	STA-25	Exhausters from W-320 are not available when needed.	Schedule + Cost
STA-13	Dilution Systems and Heat Tracing is not adequate to prevent extensive crystallization of saturated salt solutions (line plugging).	Cost	STA-27 **	Costs associated with management infrastructure portion of 230.070 that will accrue for the schedule piece that extends past March 4, 2005.	Cost

*Duration, resources, etc., should be verified by RL before proceeding.
**Derived to cover the costs associated with the variability of the final end date.

4.2.4 Category I, II, and III Mitigated Risk

The recommended approach for risk mitigation consists of examining the outstanding risks and identifying and implementing mitigating actions to reduce the likelihood or consequence of the risk. Although this method requires an additional expenditure to implement the mitigation, it is designed to reduce the overall impact of risk, and thus reduce the projected overall program cost.

This method was performed as part of this risk analysis. Some mitigation actions for risks have been included in the Project Plan cost baseline of $111,763K, as discussed in Section 4.2.1. For the remaining Category III risks (including residual risk), the recommended mitigation action is to purchase and install additional equipment at an estimated cost of $3,526K. Table 4-5 identifies this equipment and the associated cost.

Table 4-5. Category III Mitigation Description ($000s, unescalated)

Equipment	FY 1999 Cost
Design, Procure, and Install PIC Skid (2 each)	395
Design, Procure, and Install Flammable Gas Monitors (2 each)	272
Design and Procure Exhauster	2,022
Upgrade Existing Exhauster and Install	684
Perform NOC for Exhausters	153
Total	**3,526**

This equipment will partially mitigate existing Category III risks as well as provide the flexibility and capability to respond to other programmatic risks. The significant Category III risks discussed in Section 4.2.3, Table 4-4, which are partially mitigated include:

- A second tank within a year will start to leak. (STA-1)
- The increase in the Potential to Emit (PTE) for SX farm exhauster during Interim Stabilization will require renegotiation with WDOH and may drive the classification to a major stack. (STA-11)
- Will not be able to ventilate C-103 without extensive modifications to the portable exhauster. (STA-22)
- Potential for Operational Safety Requirement violation increases due to multiple tanks requiring 2-hour checks. (STA-24)
- Exhausters from W-320 are not available when needed. (STA-25)

Table 4-6 shows the addition of the $3,526K for Category III Risk Mitigation in FY 1999 to ensure that equipment is available to support pumping starts.

Table 4-6. Category III Mitigation Costs ($000s, unescalated)

Description	1998	1999	2000	2001	2002	2003	2004	2005	Total
Project Plan, Rev. 1 (Section 3.3)	8,132	18,829	18,347	19,707	18,579	17.028	11,141	0	111,763
Required Cost Baseline Adjustment (Section 3.2)	0	2,807	4066	2,058	195	0	1,200	2,600	12,926
Cost to Achieve 80% Probability of Success for Categories I and II (Section 4.2.2)	0	280	291	282	243	221	160	34	1,511
Category III Unmitigated Risk (Section 4.2.3)		3,397	3.519	3,417	2,948	2,673	1,938	408	18,300
Subtotal	8,132	25,313	26,223	25,464	21,965	19,922	14,439	3,042	144,500
Category III Mitigation Cost	**0**	**3,526**	**0**	**0**	**0**	**0**	**0**	**0**	**3,526**
Total	8,132	28,839	26,223	25,464	21,965	19,922	14,439	3,042	148,026

The curve shown in Figure 4-3 reflects the final mitigation plan and includes the results of incorporating the $3,526K Category III Mitigation Cost to reduce the $18,300K in Category III unmitigated cost or risk exposure. The unmitigated risk exposure is, in fact, reduced from $18,300K to $4,774K. The $4,774K is the additional cost allowance required to manage remaining Category III risks and residual risks at an 80% probability of success.

Figure 4-3. Category I, II, III for Cost with Mitigations

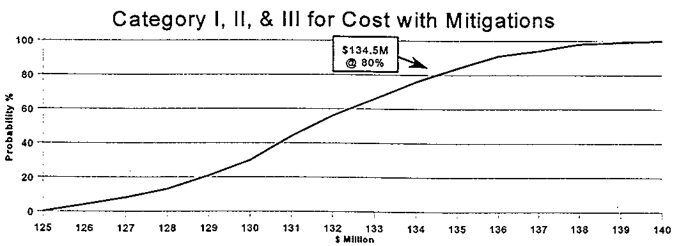


Table 4-7 shows the Category III risk allowance adjustment consistent with the Figure 4-3 curve.

Table 4-7. Category III 80% Risk Allowance ($000s)

Description	1998	1999	2000	2001	2002	2003	2004	2005	Total
Project Plan, Rev. 1 (Section 3.2)	8,132	18,829	18,347	19,707	18,579	17,028	11,141	0	111,763
Required Cost Baseline Adjustment (Section 3.3)	0	2,807	4,066	2,058	195	0	1,200	2,600	12,926
Cost to Achieve 80% Probability of Success for Categories I & II (Section 4.2.2)	0	280	291	282	243	221	160	34	1,511
Category III Unmitigated Risk (Section 4.2.3)		3,397	3.519	3,417	2,948	2,673	1,938	408	18,300
Category III Mitigation Cost (Section 4.2.4)	0	3,526	0	0	0	0	0	0	3,526
Subtotal	8,132	28,839	26,223	25,464	21,965	19,922	14,439	3,042	148,026
Category III Risk Exposure Adjustment	**–**	**(3,397)**	**(3,519)**	**(3,417)**	**(2,948)**	**(2,673)**	**(1,938)**	**(408)**	**(18,300)**
Category III Risk Allowance	**0**	**1,126**	**1,398**	**643**	**804**	**482**	**321**	**0**	**4,774**
Total Unescalated	8,132	26,568	24,102	22,690	19,821	17,731	12,822	2,634	134,500

As previously stated, the net additional cost allowance remaining after adjustment is $4,774K. The rational for time-phasing of this risk allowance is shown in Table 4-8, which is tied to pumping starts and risk allocation. This residual risk includes the extension of the schedule to June 2005 as discussed in Section 4.5.

Table 4-8. Category III Risk Allowance Time Phasing

Description	1998	1999	2000	2001	2002	2003	2004	Total
Tank Pumping Starts by Fiscal Year	3	5	7	3	5	5	1	29
Adjusted Risk Allocation*	0	7	9	4	5	3	2	30
Dollars ($000s, unescalated)	0	1,126	1,398	643	804	482	321	4,774

* The risk values were allocated by fiscal year for equivalent tanks based on factors for learning curves and complexity of tank pumping.

Examples of risks and residual risks attributable to the $4,774K exposure are:

- A second tank within a year will start to leak. (STA-1)

- The increase in the Potential to Emit (PTE) for SX farm exhauster during Interim Stabilization will require renegotiation with WDOH and may drive the classification to a major stack. (STA-11)
- Will not be able to ventilate C-103 without extensive modifications to the portable exhauster. (STA-22)
- Potential for Operational Safety Requirement violation increases due to multiple tanks requiring 2-hour checks. (STA-24)
- Exhausters from W-320 are not available when needed. (STA-25)
- The pumping durations may extend, thus causing a schedule delay. (STA-6)
- The risk for BY-105 is two-fold. The first is that technology developed is not successful to cut through the concrete layer. The second is that work within this tank will require a change to the existing Authorization Basis. (STA-8)
- The number of tanks that can be pumped simultaneously will be limited by compatibility issues. (STA-23)

4.3 ESCALATION ANALYSIS

The Project Plan estimate was escalated at an annual rate of 2.7% for FY 1999 through FY 2004. Based on direction provided from DOE and FDH for preparation of the FY 1999 MYWP, the risk analysis was escalated at an annual rate of 2.1% in FY 2000 and 2.2% for FY 2001 through FY 2004. The cost estimate is priced in FY 1999 base year dollars.

A comparison of the Project plan escalated costs and the risk analysis escalated cost is shown in Table 4-9:

Table 4-9. Escalated Cost Comparison ($000s).

Description	1998	1999	2000	2001	2002	2003	2004	2005	Total
Project Plan, Rev. 1 (Section 3.2)	8,132	18,829	18,347	19,707	18,579	17,028	11,141	0	111,763
Escalation Cost	0	508	1,003	1,640	2,090	2,426	1,931	0	9,598
Total Cost (escalated)	**8,132**	**19,337**	**19,350**	**21,347**	**20,669**	**19,454**	**13,072**	**0**	**121,361**
Cumulative Escalation Rate (Project Plan)	N/A	2.7%	5.5%	8.3%	11.2%	14.2%	17.3%	0	N/A
Risk Analysis Cost (Section 4.2.4)	8.132	26,568	24,102	22,690	19,821	17,731	12,822	2,634	134,500
Escalation Cost	N/A	N/A	506	986	1,316	1,594	1,460	364	6,227
Total Cost (escalated)	**8,132**	**26,568**	**24,608**	**23,676**	**21,138**	**19,325**	**14,282**	**2,998**	**140,727**
Cumulative Escalation Rate (Risk Analysis)	N/A	N/A	2.1%	4.3%	6.6%	9.0%	11.4%	13.8%	N/A

4.4 FY 1998 ACTUALS

The unescalated Project Plan baseline of $111,763K described in Section 3.2 is for the period June 1, 1998, through September 30, 2004. Actual costs incurred from October 1, 1997, through May 30, 1998, should be added to represent the aggregate FY 1998 as shown in Table 4-10.

Table 4-10. Actual Costs Incurred in FY 1998 ($000s, unescalated).

Description	October - May FY 1998 Actuals
Sustaining Operations	3,079
Minimum Safe Operations Suppport	1,600
Total	4,670

The Sustaining Operations supports the continuation of all tank pumping activities which were ongoing at the end of FY 1997 and provides 30-day Emergency Pumping Response to a previously unknown "leaking" tank. The Minimum Safe Operations support consists of approximately 10% of the SST Minimum Safe Operations costs supporting transfers, procedures, maintenance activities, ESH&Q support, etc., associated with saltwell pumping.

In addition, Table 4-11 shows a $0.5M work scope deferral from FY 1998 to FY 1999. The deferral would be to WBS Activity 1.01.02.01.04.39.03, Project Management, as described in Section 3.2, Table 3-4, due to delays in personnel training needs.

These adjustments result in the following revised total cost requirements as shown in Table 4-11.

Table 4-11. Deferral Results. ($000s).

Description	1998	1999	2000	2001	2002	2003	2004	2005	Total
Cumulative Balance from Section 4.3	8,132	26,568	24,608	23,676	21,138	19,325	14,282	2,998	140.727
October - May Actuals	4,670	0	0	0	0	0	0	0	4,670
Training Delays	(500)	500	0	0	0	0	0	0	0
Total Cost Baseline	12,302	27,068	24,608	23,676	21,138	19,325	14,282	2,998	145,397

4.5 SCHEDULE RISK ANALYSIS

The schedule risk analysis was performed on a summary version of the Project Plan schedule. This summary version included each of the twenty-nine tanks remaining to be pumped, the up-front preparation activities for each of those tanks (installation of flammable gas monitors, instrument skids, and exhausters, where applicable), and the post-pumping isolation step for each of the tanks. A printout of this summary schedule is included as Appendix B to this report. This appendix contains a printout of the summary schedule used as the basis of the schedule risk analysis. It is in standard Primavera Project Planner (P3) format. Two notes may be helpful in understanding this schedule:

1. For some of the tanks scheduled to be pumped early in the program, the preparation activities (installation and testing of PIC Skids, WFIE cabinets, flammable gas monitors, and exhausters) are shown as commencing on June 1, 1998. This is an artifact of the scheduling process resulting from the fact that these activities have no predecessor activities in the schedule. In fact, these activities are assumed to be accomplished so as not to delay start of actual tank pumping.

2. Various "STA" activities are shown in the schedule. These are activities associated with various Category III risks. Their durations may be zero or non-zero depending on the particular schedule case being run.

The schedule incorporates constraints recognizing that flammable gas monitors, instrument skids, and exhausters are scheduled to be used by various tanks during the SST Interim Stabilization Project. If the pumping duration of a particular tank is longer than expected, one or more pieces of hardware may not be available as scheduled for use by other tanks.

The summary schedule also includes a constraint that each tank will begin pumping *not sooner than* the early start date contained in the full SST Interim Stabilization Project schedule. This constraint was incorporated into the summary schedule in order to account for the need to maintain a constrained funding profile. It has been determined by SST Interim Stabilization Project personnel that, due to funding and personnel constraints, individual tanks cannot begin pumping significantly sooner than nominally scheduled. Table 4-12 presents the constrained pumping start date assumed for each tank.

Table 4-12. Constrained Pumping Start Dates

Tank	Start Date	Tank	Start Date	Tank	Start Date
A-101	September 1, 1999	S-109	August 1, 2000	T-110	June 1, 1998
AX-101	December 1, 1999	S-111	September 1, 2000	U-102	December 1, 2002
BY-105	October 1, 1999	S-112	November 1, 2000	U-103	June 30, 2002
BY-106	November 1, 1999	SX-101	March 1, 2002	U-105	February 1, 2003
C-103	August 31, 2001	SX-102	December 1, 2001	U-106	November 1, 2003
S-101	October 1, 1999	SX-103	October 1, 2001	U-107	October 1, 2002
S-102	February 18, 1999	SX-104	June 1, 1998	U-108	July 1, 2002
S-103	March 27, 1999	SX-105	May 1, 2001	U-109	January 1, 2003
S-106	February 17, 1999	SX-106	October 23, 1998	U-111	November 1, 2002
S-107	September 1, 2000	T-106	June 1, 1998		

In order to perform a Monte Carlo schedule analysis, uncertainty data (probability distributions) were required for all activities in the summary schedule. These uncertainty data were obtained from interviews with SST Interim Stabilization Project personnel at the same time as the cost uncertainty data were obtained.

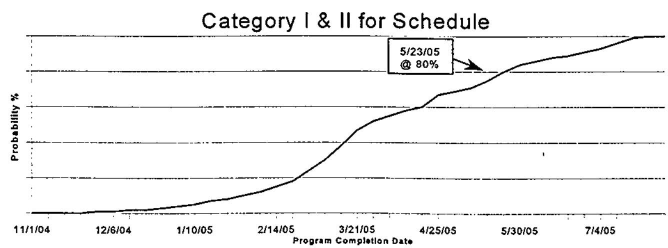
A major uncertainty in the schedule analysis is that associated with the total length of time required to pump the individual tanks. The nominal (i.e., best estimate) total tank pumping times used for the analysis are based on a complete review by SST Interim Stabilization Project personnel of the tank pump time prediction methodology. In particular, the best estimate total tank pumping times were based on the following considerations:

- A 60% efficiency of pumping operations was assumed. That is, an allowance of 40% of total pumping time is made for problems that require SST pumping to be halted.
- Limited available historical data indicate that total saltwell liquid actually pumped from individual tanks has been only about 62% of the amount predicted. However, no credit has been taken for this in the total pumping time estimates.
- Time needed to empty the double-contained receiver tanks (DCRTs), which require SST pumping to be halted, has been explicitly accounted for in the total pumping time calculations. (These were not included in the Project Plan).

The best estimate total pumping times for each tank were estimated based on these considerations, extending the base completion from September 30, 2004, to March 4, 2005 as discussed in Section 3.4. In addition, the risk analysis assumed a variation of plus and minus 20% around the best estimate total pumping duration estimates.

Based on Category I and II activities, the "S curve" of overall SST Interim Stabilization Project completion date versus probability of success is as shown in Figure 4-4. There is an 80% estimated probability of completing the program by about May 23, 2005. This 80% completion date is approximately 2.5 months past the updated baseline date of March 4, 2005.

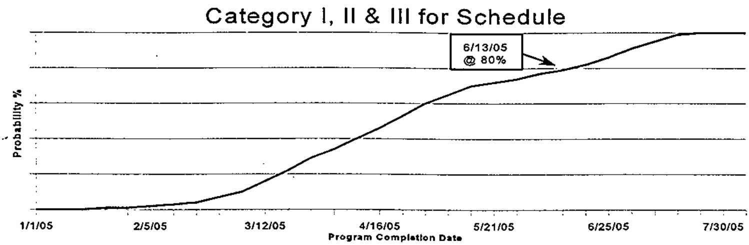
Figure 4-4. Category I & II for Schedule



The analysis incorporated the risk items as listed in Table 4-4. Activities were added to the summary schedule to represent these risks. For aggregate risks that affect several tanks or the entire program, a schedule activity was sometimes added near the end of the schedule. (The end of the schedule is the only point at which the scheduling software aggregates multiple tanks together.) Probability and consequence data for these critical risk list items were obtained from SST Interim Stabilization Project personnel.

The results of the analysis including Category I, II, and III are presented in Figure 4-5. There is an 80% probability of completing the SST Interim Stabilization Project by approximately June 12, 2005. This 80% completion date represents about a 9 ½ months extension to the baseline schedule, which targets project completion for September 30, 2004.

Figure 4-5. Category I, II, & III for Schedule



Finally, a schedule analysis was performed assuming that the risk mitigation actions suggested by the cost risk analysis are implemented. The mitigation actions consist of purchasing additional equipment (exhausters, instrument skids, and flammable gas monitors). These mitigations have only a few day's effect on the schedule date at 80% probability of success. (The curve is not presented here).

Table 4-13 presents a summary of the data from the schedule "s curves."

Table 4-13. Summary of the Data from the Schedule "S-Curves."

Category I and II		Category I, II, and III	
Probability of Success	Date	Probability of Success	Date
0%	Sept. 30, 2004	0%	Sept. 30, 2004
80%	May 23, 2005	80%	June 13, 2005

As with the cost risk analysis, the schedule risk analysis suggests actions that may be taken to increase the SST Interim Stabilization Project probability of success to 80%. The schedule risk analysis suggests that, based on the current budget profile, the SST Interim Stabilization Project schedule should be extended until approximately June 13, 2005, to allow an 80% probability of success.

5.0 CONCLUSION

The Project Plan is achievable at an 80% probability of success provided the requirements identified by this cost and schedule risk analysis are implemented:

- Revise the cost and schedule to include the $12,926K in scope for the baseline adjustments and $3,526K in scope for the risk mitigation.
- Increase the cost for Categories I and II include $1,511 for 80% probability of success.
- Fund the $4,774K for Category III risk allowance and $1,341 for 80% probability of success (Categories I and II).
- Accelerate the waste compatibility analysis and negotiations with DOE to ensure the co-mingling issues do not alter pump start dates.
- Extend schedule through June 2005.

The following cost profiles summarize and describe the cost requirements necessary to achieve an 80% probability of success based on the risk analysis of the Project Plan.

Table 5-1 shows the time-phased cost profile (by fiscal year) for the Project Plan, the results from the risk analysis, and the net change (increase) required. Further subdivision shows actuals, estimate to complete, escalation, and grand total.

Table 5-1. Cost Profile ($000s).

Project Plan

Description	1998	1999	2000	2001	2002	2003	2004	2005	Total
FY 1998 Actuals thru May (Section 4.4)	4,670	0	0	0	0	0	0	0	4,670
Scope Deferral	(500)	500	0	0	0	0	0	0	0
Estimate to Complete (Section 3.2)	8,132	18,829	18,347	19,707	18,579	17,028	11,141	0	111,763
Escalation (Section 4.3)	0	508	1,003	1,640	2.090	2,426	1,931	0	9.598
Total	12,802	19,337	19,350	21,347	20,669	19,454	13,072	0	126,031

Risk Analysis

Description	1998	1999	2000	2001	2002	2003	2004	2005	Total
FY 1998 Actuals thru May (Section 4.4)	4,670	0	0	0	0	0	0	0	4,670
Scope Deferral (Section 4.4)	(500)	500	0	0	0	0	0	0	0
Estimate to Complete (Section 3.2)	8,132	26,568	24,102	22,680	19,821	17,731	12,822	2,634	134,500
Escalation (Section 4.3)	N/A	N/A	506	986	1,316	1,594	1,460	364	6,227
Total (escalated)	12,302	27,068	24,608	23,676	21,138	19,325	14,282	2,998	145,397

Net Change

Description	1998	1999	2000	2001	2002	2003	2004	2005	Total
FY 1998 Actuals thru May (Section 4.4)	0	0	0	0	0	0	0	0	0
Scope Deferral (Section 4.4)	(500)	500	0	0	0	0	0	0	0
Estimate to Complete (Section 3.2)	0	7,739	5,755	2,983	1,242	703	1,681	2,634	22,737
Escalation (Section 4.3)	N/A	(508)	(497)	(654)	(774)	(832)	(471)	364	(3,371)
Total	(500)	7,731	5,258	2,329	469	(129)	1,210	2,998	19,366

Table 5-2, Costs by Item, shows the time-phased (estimate to complete) cost by fiscal year (FY 1998 through FY 2005) for each element of risk mitigation.

Table 5-2. Costs by Item ($000s)

Description	1998	1999	2000	2001	2002	2003	2004	2005	Total
Required Cost Baseline Adjustment (Section 3.3)	0	2,807	4,066	2,058	195	0	1,200	2,600	12,926
Cost to Achieve 80% Probability of Success for Cat. I and II (Section 4.2.2)	0	280	291	282	243	221	160	34	1,511
Category III Mitigation Cost (Section 4.2.4)	0	3,526	0	0	0	0	0	0	3,526
Category III 80% Risk Allowance (Section 4.2.4)	0	1,125	1,398	643	804	482	321	0	4,774
Total	0	7,739	5,755	2,983	1,242	703	1,681	2,634	22,737

Baseline adjustments are additional scope items that need to be added to the baseline to achieve the mission. They were identified during the risk analysis. They are not risk-related items, but rather omissions from the Project Plan, as discussed in Section 3.3

Recommended Additional Cost for 80% Probability of Success (Categories I and II) are required to achieve 80% probability of success on the Category I and II budget. These data were derived from the model cost curves as discussed in Section 4.2.2.

Category III mitigation costs need to be included in the baseline to achieve the mission. These items were identified during the risk analysis as discussed in Section 4.2.4.

Category III risk value is the result from risk analysis and data modeling that were performed. This was discussed in Section 4.2.4.

6.0 SCHEDULE RISK UNCERTAINTY

As mentioned in section 4.6, the Monte Carlo risk analysis utilized an uncertainty of plus and minus 20% for the tank pumping durations. Pumping durations are the largest unknown . Two examples of major uncertainty in the actual pump times are (1) the physical composition of the waste in the individual tanks, and (2) the physics of the interstitial migration of liquid through the waste material.

For illustrative purposes, the pumping duration uncertainty values were analyzed by repeating the analysis calculations using plus and minus 50% as the pumping duration uncertainty rather than plus and minus 20%. The results of these additional calculations, along with the results of the original plus and minus 20% calculations, are presented in the Table 6-1.

Table 6-1. Schedule Results

	Category I and II	Category I, II and III
+/- 20%	0% Sept. 30, 2004 80% May 23, 2005	0% Sept. 30, 2004 80% June 13, 2005
+/- 50%	0% Sept. 30, 2004 80% Nov. 7, 2005	0% Sept. 30, 2004 80% Dec. 06, 2005

The results based on plus and minus 50% pumping time uncertainty indicate 80% probability dates 5 to 6 months later than the 20% results. The conclusions of this analysis presented in Section 5.0 should be caveated in the context of the pumping time sensitivity. Also, because of this unknown, it is suggested that tank starts are a more controllable basis of *Hanford Federal Facility Agreement and Consent Order* negotiations, rather than completion events.

7.0 REFERENCES

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APPENDIX A

Risk Data Forms

TBR Costs and Enabling Assumptions

TBR Number: ____________

Title: ____________ **TBR Manager:** ____________

	Minimum	Most Likely	Maximum	Rationale
Baseline Budget ($K)				
Baseline Schedule (Calendar Days)				

Enabling Assumptions
1.
2.
3.
4.
5.

Notes:

Prepared by: ____________ Date: ____________

H:/common/riskmgmt/twrd/template/All Risk_forms.xls 31 July 1998

Risk Analysis Data Input Sheet

Risk Number: ____________ Risk Manager: ____________

Risk Title: ____________

Are the costs of handling this risk already included in the budget? ____________

Is this Risk linked to an Enabling Assumption? ____________

If so, which Enabling Assumption ? ____________

Is this Risk a Critical Risk? ____________

Risk Statement

Risk Quantification (Original)	MINIMUM	MOST LIKELY	MAXIMUM
Likelihood (%)			
Consequence: ($K)			
(Calendar Days)			

Handling Action Type (Select the Appropriate Box)					
Avoid	Control	Share	Transfer	Assume	Defer

	MINIMUM	MOST LIKELY	MAXIMUM
Risk Handling Action Costs			

Residual Risk Quantification	MINIMUM	MOST LIKELY	MAXIMUM
Likelihood (%)			
Consequence: ($K)			
(Calendar Days)			

Notes:

Prepared by: ____________ Date: ____________

Handling Action Plan Worksheet

Risk #: ____________ **Date:** ________________

Responsible Person: ____________

P3 Activity ID #: [ ]

Risk Statement

Handling Action Type (Select the Appropriate Box)					
Defer	Transfer	Avoid	Assume	Control	Share
A. & D.	B. thru D.	D. & E.	D.	E. thru I.	B. thru I.
ation in the indicated blocks.					

A. Review Date:
B. Point of Contact:
C. MOA # :

D. Rationale

E. Action Plan Summary

F. Closure Criteria

G. Resources:

H. Cost ($K)

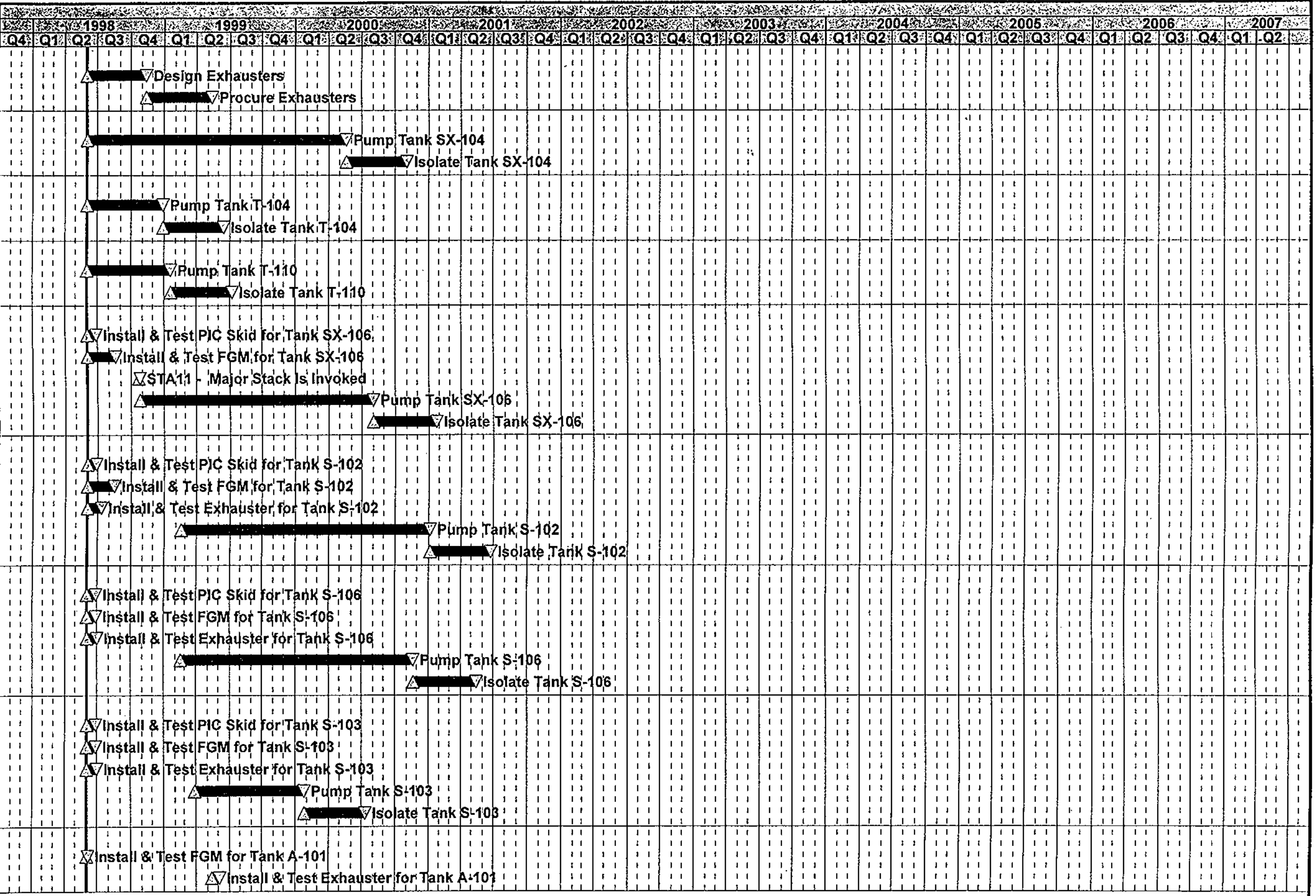
Min:
Likely:
Max:
Funded: Y N

I. Action Steps/Details of Plan	Responsibility	Due	Complete

H:/common/riskmgmt/twrd/projects/template/All Risk_forms.xls 31 July 1998

APPENDIX B

Project Plan Summary Schedule



Project Start	01OCT97
Project Finish	04MAR05
Data Date	01JUN98
Run Date	31JUL98

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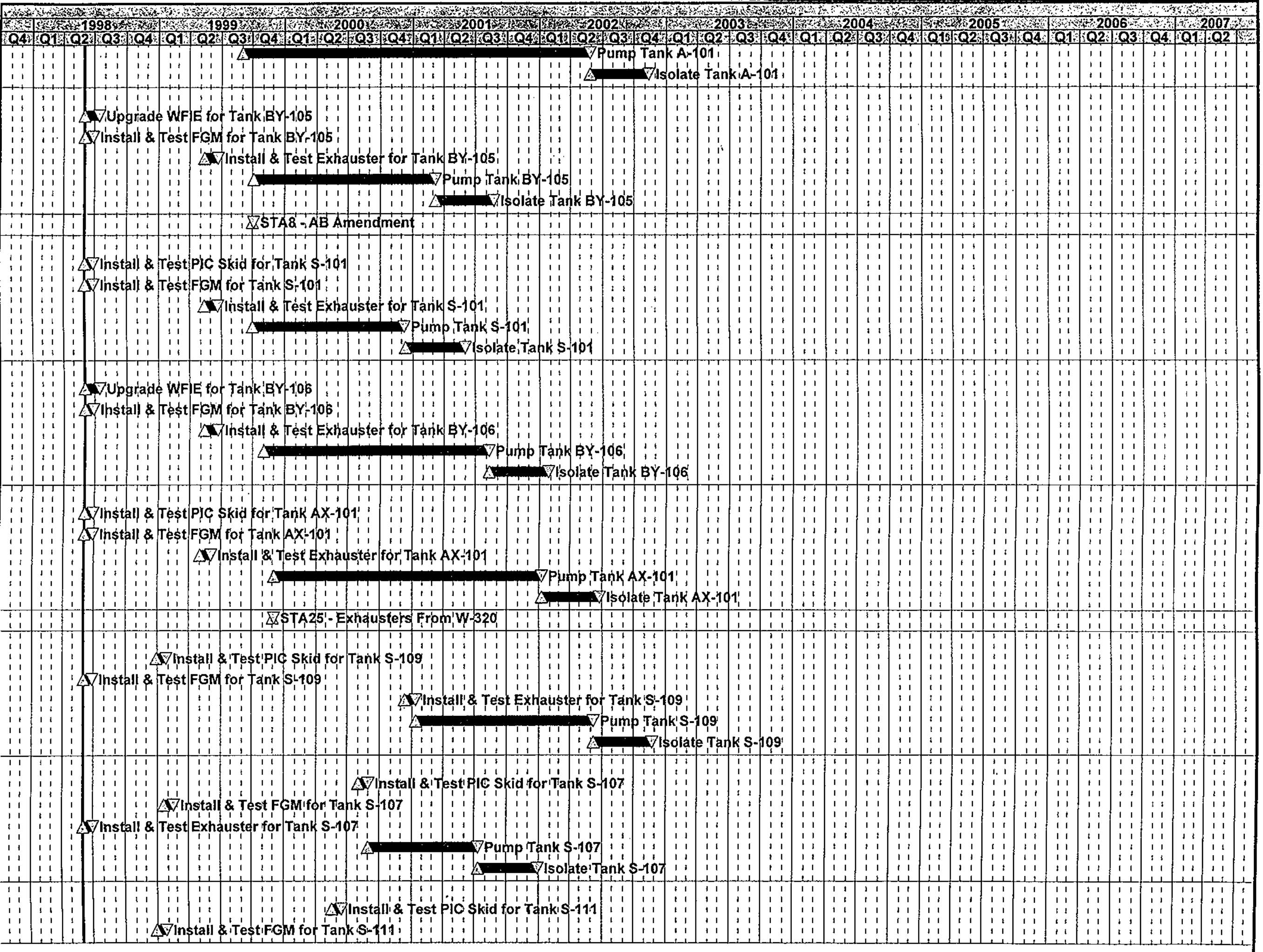
Early Bar
Progress Bar
Critical Activity

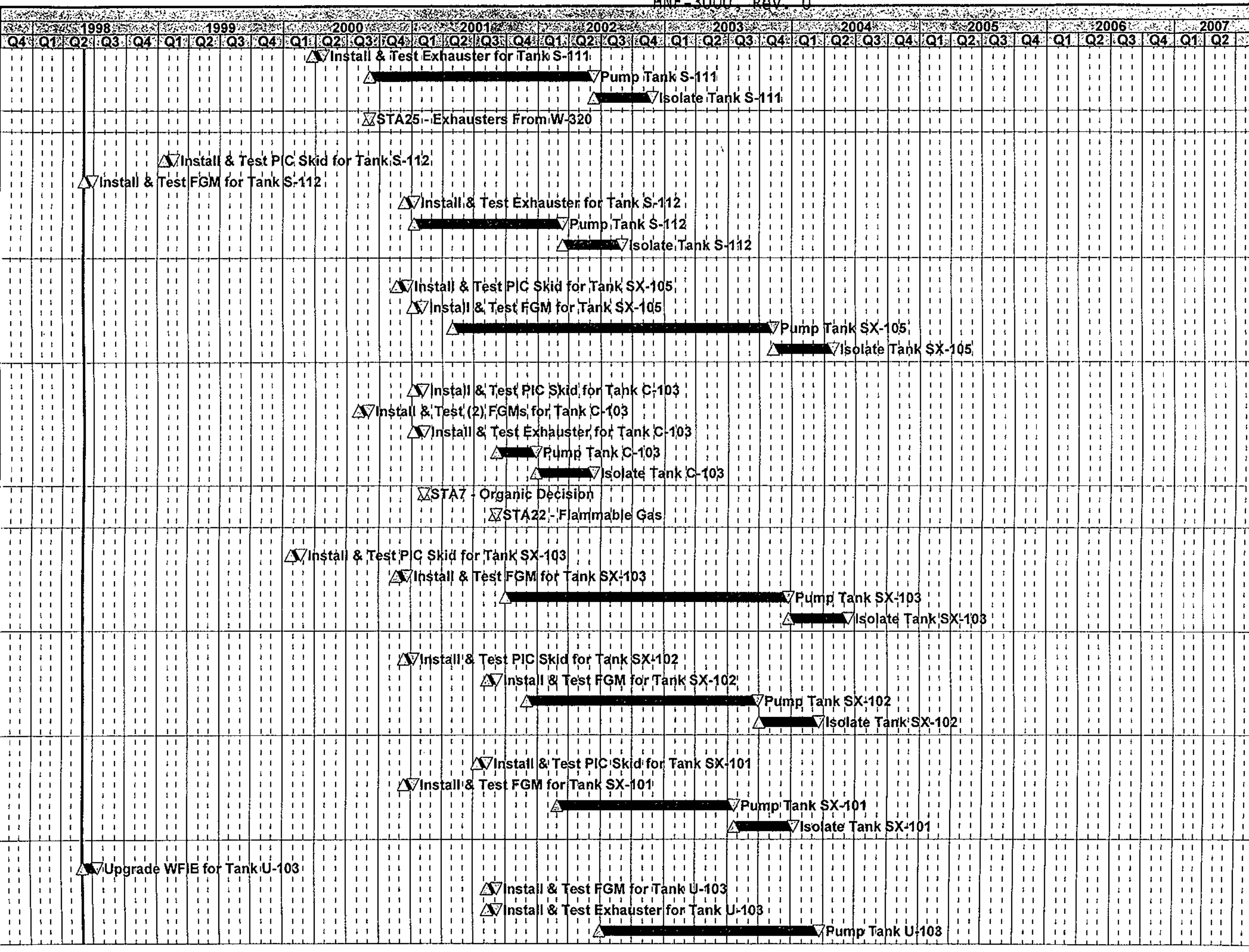
ST40

Sheet 1 of 5

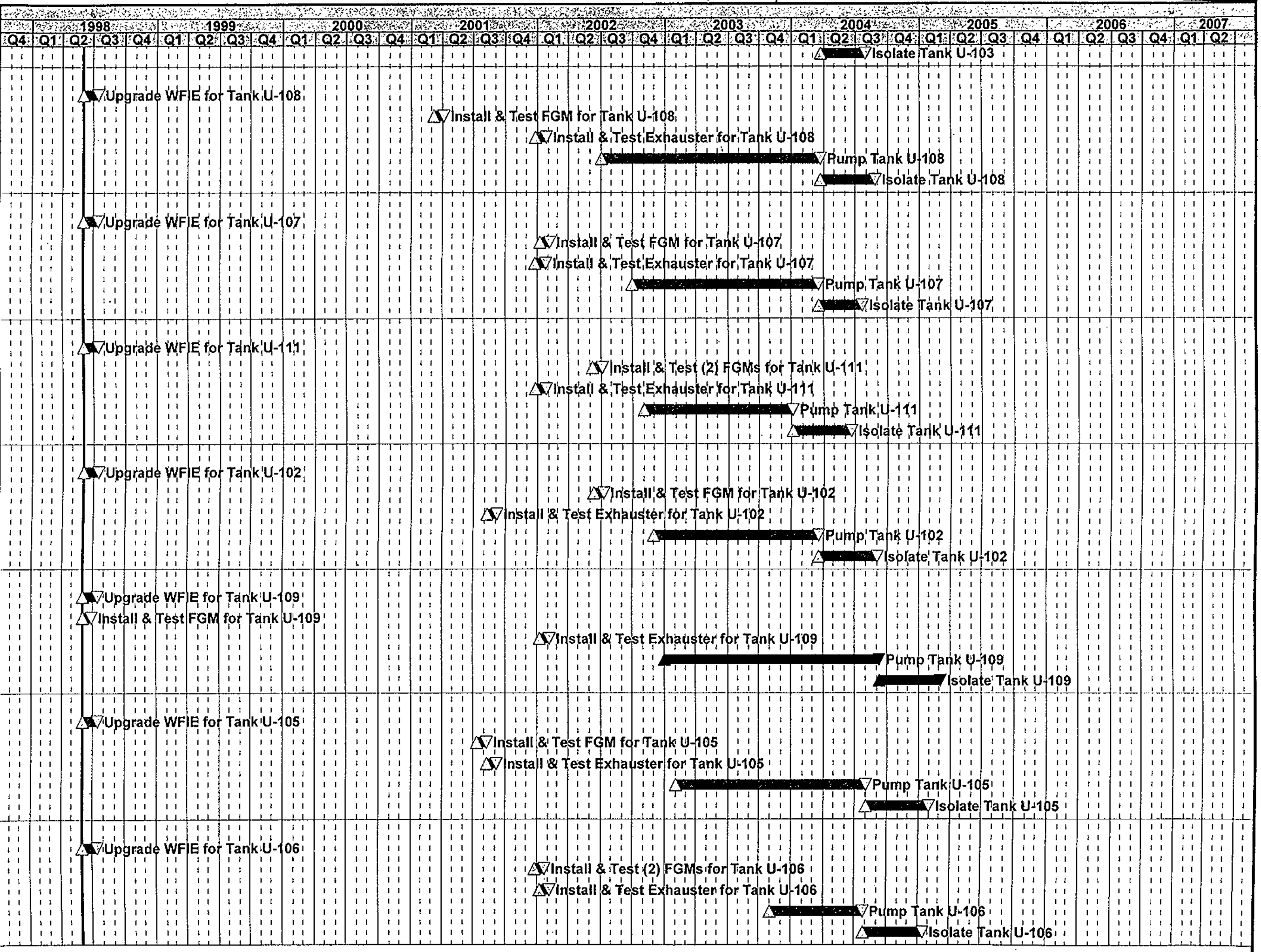
LMHC

SSTIS Summary Schedule


1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
Q4 Q1 Q2 Q3 Q4 Q1 Q2 Q3 Q4 Q1 Q2 Q3 Q4 Q1 Q2 Q3 Q4 Q1 Q2 Q3 Q4 Q1 Q2 Q3 Q4 Q1 Q2 Q3 Q4 Q1 Q2 Q3 Q4 Q1 Q2 Q3 Q4 Q1 Q2
Pump Tank A-101
Isolate Tank A-101
Upgrade WFIE for Tank BY-105
Install & Test FGM for Tank BY-105
Install & Test Exhauster for Tank BY-105
Pump Tank BY-105
Isolate Tank BY-105
STA8 - AB Amendment
Install & Test PIC Skid for Tank S-101
Install & Test FGM for Tank S-101
Install & Test Exhauster for Tank S-101
Pump Tank S-101
Isolate Tank S-101
Upgrade WFIE for Tank BY-106
Install & Test FGM for Tank BY-106
Install & Test Exhauster for Tank BY-106
Pump Tank BY-106
Isolate Tank BY-106
Install & Test PIC Skid for Tank AX-101
Install & Test FGM for Tank AX-101
Install & Test Exhauster for Tank AX-101
Pump Tank AX-101
Isolate Tank AX-101
STA25 - Exhausters From W-320
Install & Test PIC Skid for Tank S-109
Install & Test FGM for Tank S-109
Install & Test Exhauster for Tank S-109
Pump Tank S-109
Isolate Tank S-109
Install & Test PIC Skid for Tank S-107
Install & Test FGM for Tank S-107
Install & Test Exhauster for Tank S-107
Pump Tank S-107
Isolate Tank S-107
Install & Test PIC Skid for Tank S-111
Install & Test FGM for Tank S-111


1998 1999 2000 2001 2002 2003 2004 2005 2006 2007
Q4 Q1 Q2 Q3 Q4 Q1 Q2 Q3 Q4 Q1 Q2 Q3 Q4 Q1 Q2 Q3 Q4 Q1 Q2 Q3 Q4 Q1 Q2 Q3 Q4 Q1 Q2 Q3 Q4 Q1 Q2 Q3 Q4 Q1 Q2 Q3 Q4 Q1 Q2
Install & Test Exhauster for Tank S-111
Pump Tank S-111
Isolate Tank S-111
STA25 - Exhausters From W-320
Install & Test PIC Skid for Tank S-112
Install & Test FGM for Tank S-112
Install & Test Exhauster for Tank S-112
Pump Tank S-112
Isolate Tank S-112
Install & Test PIC Skid for Tank SX-105
Install & Test FGM for Tank SX-105
Pump Tank SX-105
Isolate Tank SX-105
Install & Test PIC Skid for Tank C-103
Install & Test (2) FGMs for Tank C-103
Install & Test Exhauster for Tank C-103
Pump Tank C-103
Isolate Tank C-103
STA7 - Organic Decision
STA22 - Flammable Gas
Install & Test PIC Skid for Tank SX-103
Install & Test FGM for Tank SX-103
Pump Tank SX-103
Isolate Tank SX-103
Install & Test PIC Skid for Tank SX-102
Install & Test FGM for Tank SX-102
Pump Tank SX-102
Isolate Tank SX-102
Install & Test PIC Skid for Tank SX-101
Install & Test FGM for Tank SX-101
Pump Tank SX-101
Isolate Tank SX-101
Upgrade WFIE for Tank U-103
Install & Test FGM for Tank U-103
Install & Test Exhauster for Tank U-103
Pump Tank U-103

Sheet 3 of 5


1998
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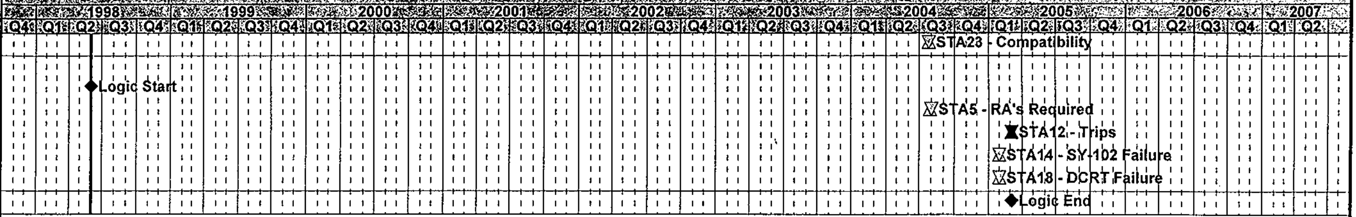
Isolate Tank U-103
Upgrade WFIE for Tank U-108
Install & Test FGM for Tank U-108
Install & Test Exhauster for Tank U-108
Pump Tank U-108
Isolate Tank U-108
Upgrade WFIE for Tank U-107
Install & Test FGM for Tank U-107
Install & Test Exhauster for Tank U-107
Pump Tank U-107
Isolate Tank U-107
Upgrade WFIE for Tank U-111
Install & Test (2) FGMs for Tank U-111
Install & Test Exhauster for Tank U-111
Pump Tank U-111
Isolate Tank U-111
Upgrade WFIE for Tank U-102
Install & Test FGM for Tank U-102
Install & Test Exhauster for Tank U-102
Pump Tank U-102
Isolate Tank U-102
Upgrade WFIE for Tank U-109
Install & Test FGM for Tank U-109
Install & Test Exhauster for Tank U-109
Pump Tank U-109
Isolate Tank U-109
Upgrade WFIE for Tank U-105
Install & Test FGM for Tank U-105
Install & Test Exhauster for Tank U-105
Pump Tank U-105
Isolate Tank U-105
Upgrade WFIE for Tank U-106
Install & Test (2) FGMs for Tank U-106
Install & Test Exhauster for Tank U-106
Pump Tank U-106
Isolate Tank U-106



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Q4 Q1 Q2 Q3 Q4 Q1 Q2 Q3 Q4 Q1 Q2 Q3 Q4 Q1 Q2 Q3 Q4 Q1 Q2 Q3 Q4 Q1 Q2 Q3 Q4 Q1 Q2 Q3 Q4 Q1 Q2 Q3 Q4 Q1 Q2 Q3 Q4 Q1 Q2
STA23 - Compatibility
Logic Start
STA5 - RA's Required
STA12 - Trips
STA14 - SY-102 Failure
STA18 - DCRT Failure
Logic End

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