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7. Abstract

Based on a review of factors that influence the need for waste storage systems, and hence the MWTF, two new tanks need to be built in the 200 West Area as soon as practicable. Design should continue for the tanks in the 200 East Area. Construction of the Cross-Site Transfer System should proceed as scheduled.

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POSITION PAPER

NEED FOR ADDITIONAL WASTE STORAGE CAPACITY AND RECOMMENDED PATH FORWARD FOR PROJECT W-236A, MULTI-FUNCTION WASTE TANK FACILITY

SUMMARY

Project W-236a, Multi-Function Waste Tank Facility (MWTF), was initiated to increase the safe waste storage capacity for the Tank Waste Remediation System (TWRS) by building two new one million gallon underground storage tanks in the 200 West Area and four tanks in the 200 East Area. Construction of the tanks was scheduled to begin in September 1994 with operations beginning in calendar year (CY) 1998. However, recent reviews have raised several issues regarding the mission, scope, and schedule of the MWTF.

The decision to build new tanks must consider several elements, such as:

- Operational risk and needs - Operational risk and flexibility must be managed such that any identified risk is reduced as soon as practicable.
- The amount of waste that will be generated in the future - Additional needed tank capacity must be made available to support operations and maintain currently planned safety improvement activities.
- Safety issues - The retrieval of waste from single-shell tanks (SSTs) and watch list tanks will add to the total amount of waste that must be stored in a double-shell tank (DST).
- Availability of existing DSTs - The integrity of the 28 existing DSTs must be continuously managed.
- Affect on other projects and programs - Because MWTF systems have been integrated with other projects, a decision on one project will affect another. In addition the W-236a schedule is logically tied to support retrieval and safety program plans.

Based on the above, two new tanks are needed for safe waste storage in the 200 West Area, and they need to be built as soon as practicable. Design should continue for the tanks in the 200 East Area with a decision made by September, on whether to construct them. Construction of the cross-site transfer line should proceed as scheduled. To implement this recommendation several actions need to be implemented.

INTRODUCTION

The mission of Project W-236a, MWTF, is to increase the safe waste storage capacity in TWRS by building six new one million gallon underground storage tanks. The current baseline is to build two of these tanks in 200 West Area, and four in 200 East Area. Before the selection of the MWTF one million gallon configuration, alternate tank design concepts were considered for these tanks (Kaiser Engineers Hanford Company, 1992). The current schedule calls for construction of these tanks to begin in September 1994 with operations beginning in CY 1998. However, recent reviews have raised several issues regarding the mission, scope, and schedule of the MWTF.

Related Projects W-028, Aging Waste Transfer Line, and W-058, Cross-Site Transfer System, will provide upgraded capability to transfer waste between the 200 West and 200 East Areas. The schedules for these projects call for construction to begin in November 1995 with the transfer line becoming operational in 1998.

An Environmental Impact Statement (EIS) for the construction of the MWTF and Cross-Site Transfer System has been prepared. The Record of Decision has been delayed and now is expected to be issued in March 1995.

To address the MWTF Project reviews, and to decide if and how many additional tanks are needed (on a preliminary basis), factors that influence the need for new tanks were reviewed and are discussed below. Once the need for tanks was assessed, a path forward to implement the decision was identified.

DISCUSSION OF THE NEED FOR ADDITIONAL TANKS

The decision to build new tanks, and if so how many, must address several factors, such as operational risk and needs, the amount of waste that the site will generate in the future, safety, availability of existing DSTs, and impact on other projects. Operational risk and flexibility must be managed such that any identified risk is reduced as soon as practicable, and additional needed tank capacity must be made available to support operations. The retrieval of waste from SSTs and watch list tanks will require subsequent storage in a DST, and therefore, will add to the total amount of waste that must be stored. The aging condition of the existing 28 DSTs becomes significant as time passes. Also, other projects depend on Project W-236a (e.g., integration and utilization of common utilities, systems, and support facilities). Personnel responsible for the following subjects provided the subsequent discussions on the impact of building or not building new tanks.

Operational Risk and Needs

Operational needs with respect to new storage tanks revolve around the need to maintain compliance with:

- DOE Order 5820.2A, "Radioactive Waste Management", which requires spare capacity equal to the volume of liquid in any one high-level waste tank
- The Washington Administrative Code (WAC) regarding double containment of tanks and interconnecting transfer lines
- The Tri-Party Agreement (TPA) regarding the removal of pumpable liquids from non-compliant SSTs
- The Wyden Bill that precludes addition of waste to watch list tanks

These requirements and current tank status converge to cause a particularly acute non-compliance situation in the 200 West Area Tank Farms. There are only three DSTs in 200 West Area, two of which are on the watch list, 241-SY-101 and 241-SY-103, (waste cannot be added to them) and the third, 241-SY-102, has only 300,000 gallons of capacity left and as such does not fulfill the DOE Order requirement for spare capacity. The existing cross-site transfer line is not compliant with WAC regulations and may be inoperable. Additionally, approximately 3.5 million gallons of SST pumpable liquids must be pumped (per the TPA) into 241-SY-102 and then via the cross-site transfer line to the 200 East Area Tank Farms and the Evaporator.

To alleviate the non-compliant situation in 200 West Area Tank Farms and to have a reasonable level of assurance that safe operations can be performed in the foreseeable future, new storage tanks and a compliant cross-site transfer system must be built. New tanks will reduce the operational management risk by providing flexibility and contingency for future storage operations. This flexibility is needed to provide space for:

- Adequate storage of waste before cross-site transfers
- Resolution of 241-SY-101 and 241-SY-103 safety issues by dilution
- Contingency storage space for SST pumpable liquid volume, uncertain evaporator concentration limits, and other waste volume uncertainties
- Mixing or dilution of waste prior to cross-site transfer
- Decoupled operations, to the extent practical, in the 200 East and West Area Tank Farms (e.g., saltwell pumping or staging, and waste preparation for future disposal)
- Contingency for evaporator operation disruptions
- Contingency for maintaining passive (versus active) safety waste storage

The new cross-site transfer system is necessary for reliability (existing lines were built in the 1950's and four of the six have failed) and to minimize the number of new storage tanks needed in the 200 West Area.

Because a need exists for new tanks, and there are operational difficulties in 200 West Area Tank Farms, the first two tanks should be placed in the 200 West Area. Operations needs additional storage space and the cross-site transfer lines to reduce the management risk of operational disruption, e.g., inability to take new wastes or to respond to future system needs. The two additional storage tanks should be added to 200 West Area Tank Farms as soon as possible to give an additional margin to regulatory requirements and to meet operational flexibility needs in the 200 West Area. A decision on the other four 200 East Area tanks can wait until resolution of technical and programmatic uncertainties.

Waste Volume Projections

In addition to evaluating a baseline operational waste volume projection case, Process Engineering evaluated an upper planning case and a lower planning case (Figure 1, Koreski and Strode, 1994). These three cases can be used to view a range of the amount of waste that is expected to require storage space with time. The three cases are based upon the assumptions listed in Table 1.

The baseline case was based on meeting TPA milestones and implementing TWRS baseline plans. It concludes that approximately five tanks are needed. The assumptions for the lower planning case were selected to give a result that required no new tanks. However, the greatest risk is associated with that case. Furthermore, DOE Order 5820.2A, TPA, and other regulations would be violated.

The upper planning case allows greater waste generations and terminal clean-out volumes, a higher dilution ratio for Tanks 241-SY-101 and 241-SY-103, a higher saltwell liquid pumping volume, etc. The operational risk is lowest, but this case would require about 13 additional tanks.

For planning purposes the baseline case offers the most manageable balance between tank space needs and risks. It includes storage space for the TWRS planned activities listed below:

- Facility generations and terminal cleanout
- SST stabilization
- 241-C-106 retrieval
- 241-SY-101 and 241-SY-103 dilution for passive mitigation
- Tank farm and evaporator operations

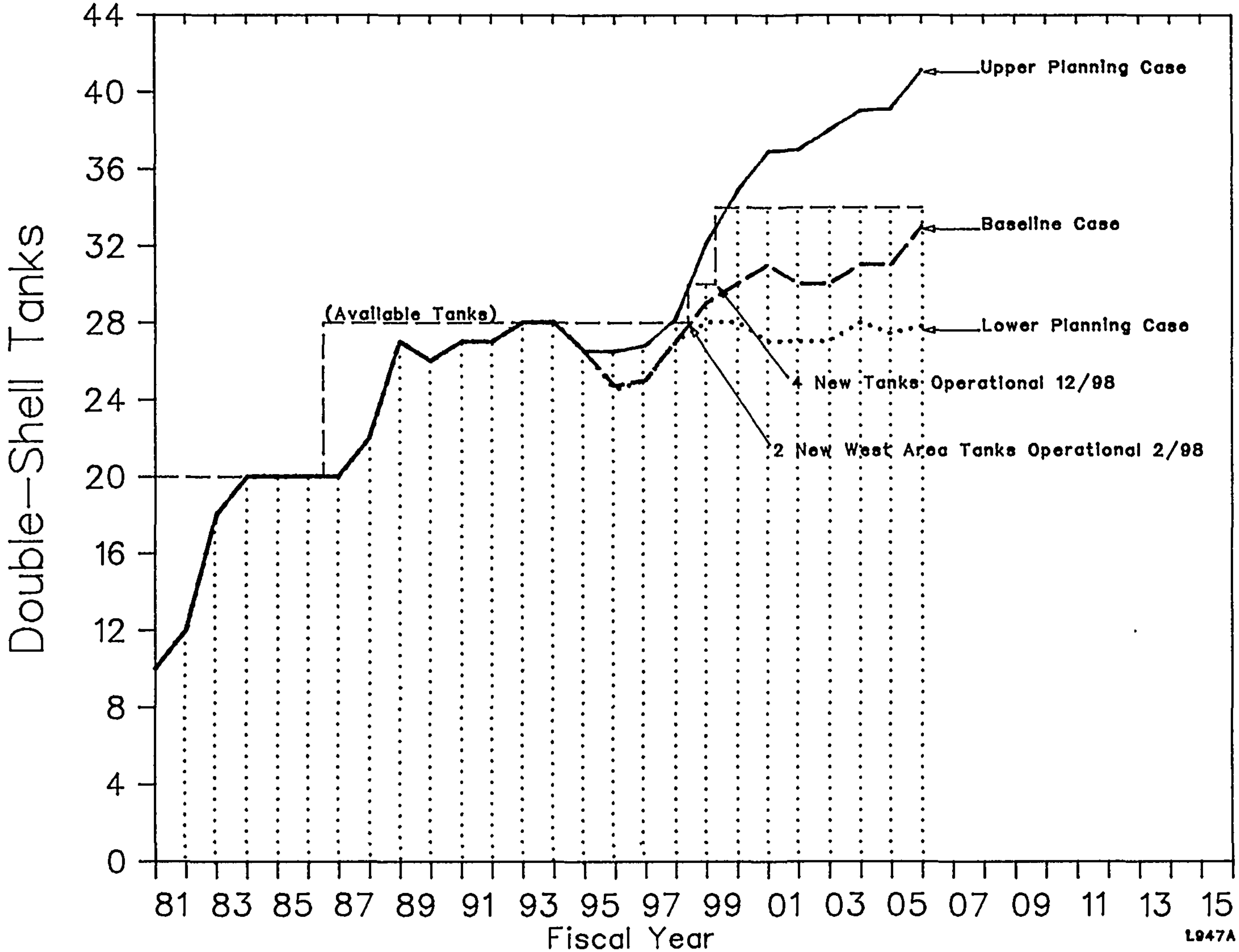

Figure 1. Comparison of the Tank Requirements for the 7/94 Projection Cases

Table 1. Summary of Assumptions For the July 1994 Projection Cases

Facility or Project	Lower Planning Case (L947LC) Assumptions	Baseline Case (L947BC) Assumptions	Upper Planning Case (L947UC) Assumptions
Total Monthly Facility Generations	64 Kgal/month	93 Kgal/month	108 Kgal/month
PUREX TCO	TCO FY94-97 (0.3 Mgal DSSF)	TCO FY94-97 (0.4 Mgal DSSF)	TCO FY94-97 (1.5 Mgal DN)
B Plant TCO	TCO FY97-01 (0.56 Mgal DN)	TCO FY97-01 (0.56 Mgal DN)	TCO FY97-01 (0.56 Mgal DN)
100 Area TCO	TCO FY95-99 (0.57 Mgal DSSF)	TCO FY95-99 (0.57 Mgal DSSF)	TCO FY95-99 (0.57 Mgal DSSF)
Evaporator Restart	04/1994; LERF 13 Mgal	04/1994; LERF 13 Mgal	04/1994; 13 Mgal LERF
Effluent Treatment Facility Startup Rate TOE	06/1995 150 gpm 70%	06/1995 150 gpm 70%	06/1996 150 gpm 70%
SST Stabilization Porosity Complexed SWL Volume Pumped	 35% 14% 3.6 Mgal by end of FY 2000	 35% 14% 3.6 Mgal by end of FY 2000	 45% 14% 5.1 Mgal by end of FY 2000
PFP Stabilization Run Startup	FY 1998	FY 1998	FY 1998
Grout	No Restart--Use Grout Feed Tanks	No Restart--Use Grout Feed Tanks	No Restart--Use Grout Feed Tanks
Tank 101-SY Dilution (Date)	No Dilution	1:1 Dilution (FY 1998)	3:1 Dilution (FY 1998)
Tank 103-SY Dilution (Date)	No Dilution	1:1 Dilution (FY 2000)	3:1 Dilution (FY 2000)
SST Solids Retrieval 106-C solids (start; receiver tank) SST Solids Retrieval Start Rate SST Waste Retrieval Complete SST Site Closure Complete	 FY 1997; Tank 102-AY 09/2003 0.2 Mgal (0.8 Total) in FY 2004; 0.3 Mgal (1.2 Total) in FY 2005 FY 2018 FY 2024	 FY 1997; Tank 102-AY 09/2003 0.2 Mgal (0.8 Total) in FY 2004; 0.3 Mgal (1.2 Total) in FY 2005 FY 2018 FY 2024	 FY 1997; Tank 102-AY 09/2003 0.2 Mgal (0.8 Total) in FY 2004; 0.3 Mgal (1.2 Total) in FY 2005 FY 2018 FY 2024
LLW Pretreatment Facility startup	12/2004	12/2004	12/2004
LLW Operational Tanks	None; Pretreatment & Vitrification are Close Coupled	3 in FY 2005; 4 in FY 2006	3 in FY 2005; 4 in FY 2006
LLW Vitrification	06/2005; 2 Mgal in 2005	06/2005; 2 Mgal in 2005	06/2005; 2 Mgal in 2005
In-Tank Washing (FY 1995-2000)	Consolidate all NCAW & 106-C solids. Consolidate all NCAW supernates.	Consolidate Washed 101-AZ & 102-AZ solids. Consolidate all NCAW supernates.	Wash Tank 101-AZ solids only.
HLW Enhanced Sludge Washing	06/2008	06/2008	06/2007
HLW Vitrification startup	12/2009	12/2009	12/2009
Evaporation Limit for Wastes--SpG	1.5	1.5	1.4
New Tanks in West Area	None	2 in 02/1998	2 in 02/1998
New Tanks in East Area	None	4 in 12/1998	4 in 12/1998
Contingency Tank	None	One starting FY 1999	One starting FY 1999
Loss of DST Space	None	None	One DST starting FY 1998

However, the baseline case has the following uncertainties that will have to be managed:

- Up to an additional 1.5 million gallons of SST liquid may need to be stored depending upon the porosity of the existing waste
- Up to an additional 1.0 million gallons of space will be required in 200 West Area, if watch list/segregation issues prevent use of existing tanks
- An additional 3.8 million gallons will be needed to mitigate 241-SY-101 and 241-SY-103, if 3:1 dilution is required .
- Up to an additional 2.0 million gallons will be required, if evaporation is limited to 1.4 grams per milliliter

Also, the baseline case assumes no failure of an existing DST.

The base case waste volume projection shows that about five tanks are needed. The model that describes the waste volume projection and the assumptions used in the model will be validated.

<u>Safety Issues</u>

Construction of new tanks is a preferred method for mitigation of flammable gas watch list tanks. These tanks include the known "burping" DSTs 241-SY-101, 241-SY-103, 241-AW-101, 241-AN-103, 241-AN-104, and 241-AN-105, as well as 19 SSTs.

Currently, Tank 241-SY-101 is being actively mitigated with a large mixer pump that was installed in 1993. After characterization of the gases and waste in the other DSTs is completed in fiscal year (FY) 1995-1996, it will be determined whether they require mitigation. Mitigation of the SSTs is similarly uncertain, and would likely be by active ventilation rather than by mixer pumps as is the case for the DSTs.

Mitigation of DSTs by mixing is a difficult and expensive activity. An initial installation costs over $10 million per tank, and replacement of a failed mixer pump costs over $5 million. Annual operating costs for Tank 241-SY-101 alone have been over $10 million. The complexity and costs increase proportionally with the number of tanks that are mitigated in this manner.

Mixer pumps are designed to operate for two to ten years, but it is difficult to predict the frequency of replacement without operational experience in the waste tanks. The motors have a historical failure rate of about 5 percent per year in less severe nuclear service. Pump replacement is expected to be a very difficult task involving high radiation dose rates to workers. An inventory of spare pumps, containers, and instrumentation systems, as well as up-to-date training and installation work plans will have to be maintained to support mixer pump operations and maintenance, because this equipment will have an important safety function.

To mitigate any flammable gas tanks by a passive means would be operationally simpler and less expensive than an active means such as mixer pumps. Two possible passive means are dilution and transfer. The new tanks could be used for this purpose. However, before either of these methods is implemented, further work is needed to determine their effectiveness. Dilution or transfer could make the gas releases worse, or could create two burping tanks instead of one. Additional studies with real waste, either in the laboratory or in-tank to resolve these questions are planned for FY 1995-1996, including possible in-tank dilution tests in Tank 241-SY-103.

Because the new tanks are already needed for other functions, (e.g., operations), they offer an attractive possible option for mitigation at little or no additional cost.

<u>Availability of Existing DSTs</u>

The DSTs confine liquid, saltcake, and sludge wastes so that these substances do not enter the environment. In this capacity, the DSTs must be structurally stable and leak tight. None of the existing DSTs has collapsed or leaked, and none are planned to be replaced. Their continued acceptable performance depends on the degree to which aging degradation affects the concrete and steel components.

In the past year, a multi-year life management plan began to address concerns about aging tanks. The plan provides for additional inspections and structural analysis updates. Completion of the tank life management activities will increase our confidence in tank life estimates and confirm if and when replacement tanks are needed.

The results expected from a revised structural analysis should show the tanks meet or exceed the demands of the next ten or more years without structural failure/collapse of the dome or walls when subjected to the normal operational loads. However, further stress analysis of the primary steel liner is needed to accurately predict long term performance and compliance with ASME Code allowables. The need for additional seismic analysis of the DSTs depends on the outcome of a review of the detailed results of seismic evaluations of Tank 241-C-106 and the MWTF.

All recent evaluations of the physical processes that might lead to a loss of primary confinement of DSTs conclude that corrosion is clearly the most likely cause of leaks from the primary tank. Tank penetration resulting from general thinning of tank walls or bottoms is judged very unlikely. This judgment is supported by examinations and analyses of leaking SSTs at Savannah River and by laboratory testing of simulated Hanford wastes. Analysis of leaking Savannah River tanks identified stress-corrosion cracking as the failure mode. This experience led to laboratory studies that defined a range of waste compositions that showed no evidence of stress-corrosion cracking in the severe constant-extension rate test.

Successful service notwithstanding, there is still uncertainty in predicting that corrosion processes will not lead to leaks in the DSTs. Both stress-corrosion cracking and pitting can be studied to a limited degree in the laboratory, but there is invariably a limit to the test durations that can be justified. These corrosion processes may exhibit long incubation times before they are observable, but once started, they can lead quite rapidly to leakage. Another source of uncertainty related to stress corrosion is the magnitude of the applied stress in the tank. Experimental stress analysis has suggested that stresses may be higher than structural analysis calculations indicate. Recent structural analysis of stresses in the concrete dome resulting from concrete creep indicates a potential for increased dome-deflection-induced stresses in the primary tank that translate to reduced protection against stress-corrosion cracking. Although the successful service experience is a positive indicator, it does not provide assurance that the tanks are immune to future corrosion that will produce leaks.

One standard method for dealing with the large uncertainty in predicting penetration of liquid-containing components by corrosion is to perform in-service inspection to monitor corrosion on the actual component over many years of service. The Tank Integrity Assessment Program is funding development of a robotic system to carry ultrasonic examination sensors into the annular space. This will be used to assess the partial penetration of the primary tank wall by pitting, stress-corrosion cracking, or general thinning. If such examinations detect partial penetration of the wall, they can be repeated periodically to provide estimates of corrosion rates and remaining life. If the examinations reveal no evidence of corrosion on the tank wall, then confidence increases that corrosion control measures are effective and will continue to be so.

In summary, to assure that structural integrity and confinement of the existing DSTs are maintained, the life management plan needs to be implemented.

Integration of MWTF with Other TWRS Projects

The MWTF has been integrated with other ongoing projects in both the 200 East and 200 West Areas such that common systems can be shared. Typical support includes:

- 200 East Area
  - Control Room space - W-028, W-058
  - Power (normal/emergency) - W-028, W-058
  - Diversion boxes - W-058
  - Pumps - W-058
  - Field offices - W-058, W-236b
  - Change rooms - W-028, W-058
  - Warehouse capabilities - W-058
  - Piping connection nozzles - W-236b

- 200 West Area
  - Control Room space - W-058, SY Farm upgrades, W-314, W-211
  - Power (normal/emergency) - W-058
  - Change room - W-211, SY Operations
  - Warehouse capabilities - W-211, Operations, W-058

Decisions to delay or cancel portions of the MWTF will shift the burden of providing these functions to other projects. A cost impact/schedule impact will occur. The magnitude of this impact is dependent upon the deviations from the current planning case for W-236a. Any decision made on W-236a must also consider the impact on these projects.

Project W-211 Implication

Project W-211 was established for DST waste retrieval for processing and to provide flexibility in maintaining adequate storage space. A sequence was set up to allow the passive mitigation of flammable gas watch list tank safety issues through the retrieval of Tanks 241-SY-101 in 1998 and 241-SY-103 in 1999. The TWRS Technical Strategy assumes that the waste will be retrieved and stored in "additional tanks".

If the W-211 project is required to conduct retrieval operations to effect passive mitigation of 241-SY-101 and 241-SY-103 in 1998 and 1999, then two options exist. The first option is to retrieve the wastes into new tanks (MWTF - West Area). The second is to retrieve the waste into new or existing tanks in the East Area through the existing or new cross-site transfer line. The second alternative appears to be of a higher risk than the first due to the current condition of the existing line and the need for in-line dilution.

If continued active mitigation is deemed to be successful, i.e., of a relatively lower risk than passive mitigation, the current plan may change and a new sequence and schedule for the project would be in order.

RECOMMENDATION

TWRS concludes that two new tanks are needed for safe waste storage in the 200 West Area and recommends that they be built as soon as practicable. Design should continue for the tanks in the 200 East Area with a decision made by September 1995 on whether to construct them. This is consistent with operational risk and needs, waste volume projections, and safety issues, because they are all influenced by SST stabilization, 241-C-106 retrieval, and 241-SY-101 and 241-SY-103 mitigation. Also, legal requirements such as those included in DOE Orders, the WAC, and the TPA will be met.

The following needs to be noted:

- This recommendation is for waste that can be currently identified. Future processes may require additional storage capacity. These additional storage needs will be identified by 1997.

- The new Cross-Site Transfer System is also needed to permit waste in the 200 West Area to be transported to the evaporator for volume reduction.

PATH FORWARD

The following steps need to be performed to implement the recommendation:

- Revise W-236a and other project baselines as required.

- Complete the EIS; revise the scope as necessary.

- Complete systems engineering to validate the need and requirements for the MWTF, Cross-Site Transfer Line, and their technical bases, by September 1995. This work includes:
  - Obtain approval of the Functions and Requirements Document from the U.S. Department of Energy (DOE).
  - Develop the Technical Requirements Baseline and obtain approval from the DOE.
  - Develop a Design Requirements Document (DRD) for MWTF.
  - Compare the MWTF DRD with the existing Functional Design Criteria.

- Perform necessary trade studies; a preliminary list of trade study topics is:
  - Passive versus active mitigation cost analysis. The cost of using active techniques for 241-SY-101 mitigation will be compiled and compared with costs incurred by passive mitigation.
  - Tank operational risks. The risk of operating the tank farm in its current mode will be evaluated for the present time and at the end of 1999. Improvements in operational risk due to the construction of new tanks will be assessed, also.
  - Retrieval sequence. Alternate waste retrieval methods and sequences will be evaluated and compared to determine the optimal method for removing the waste from the tanks. The amount of dilution required and the resulting required storage volume will be one of the evaluation criteria.

- Validate the Waste Volume Projection including assumptions. Assumptions that increase risk because of the uncertainty associated with them are:
  - 241-SY-101 and 241-SY-103 dilution ratios for retrieval. The optimum dilution ratios for these two watch list tanks will be determined to assure that the safety issues associated with flammable gases are resolved. The analysis will include both analytical and experimental approaches.
  - SST solids porosity. An assessment of the porosity will provide a better estimate of the amount of waste that still must be removed from the tanks by saltwell pumping. Historical documents and data will be reviewed, and experiments and tests will be performed as required to confirm the value.
  - Evaporator operation limits. A study of Evaporator performance will identify the specific gravity of the concentrated waste that can be achieved by evaporation and the ability of the Liquid Waste Treatment Facility to treat the liquid effluent. The affect of the concentrated waste on safe storage will be considered. Evaporator operational records as well as field sampling will be used in the study.
  - Required waste segregation. The emphasis of this study will be to investigate the impact of waste segregation on the status of watch list Tank 241-SY-103 as a potential receiving tank. This will confirm that blending waste into the contents of 241-SY-103 does not generate additional safety issues and existing ones are not aggravated.

- Complete the Cross-Site Transfer Line Project as soon as achievable.

- Conduct DOE independent design reviews.

- Decide on need for new tanks in the 200 East Area by September 1995.

- Validate assumptions and establish engineering basis for aging effects on existing 28 DSTs.

- Decide on additional tanks by 1997.

REFERENCES

W236ER3, "Engineering Report for Alternate Tank Design Concepts Project W-236," Kaiser Engineers Hanford Company, April 1992, Richland, Washington.

WHC-SD-WM-ER-029, Rev. 20, "Operational Waste Volume Projection", G. M. Koreski and J. N. Strode, July 1994, Westinghouse Hanford Company, Richland, Washington.