HANFORD SITE TANK WASTE REMEDIATION SYSTEM -A PROGRAM OVERVIEW

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ABSTRACT

The U.S. Department of Energy's (DOE) Hanford Site in southeastern Washington State has the most diverse and largest amount of highly radioactive waste of any site in the United States. High-level radioactive waste has been stored in large underground tanks since 1944. Approximately 227,000 m^3 (60 Mgal) of caustic liquids, slurries, salt cakes, and sludges have accumulated in 177 tanks. In addition, significant amounts of ^{90}Sr and ^{137}Cs were removed from the tank waste, converted to salts, doubly encapsulated in metal containers, and stored in water basins.

A Tank Waste Remediation System Program has been established within the DOE to safely manage and immobilize these wastes in anticipation of permanent disposal of the high-level radioactive waste fraction in a geologic repository. Implementing this program will require resolving several waste tank safety issues to maintain safe storage, and then retrieving, treating, and immobilizing the waste for disposal.

INTRODUCTION

The U.S. Department of Energy's (DOE) Hanford Site in southeastern Washington State has the most diverse and largest amount of highly radioactive waste of any site in the United States. A Tank Waste Remediation System (TWRS) Program has been established to safely store, treat and dispose of those wastes. This paper describes the TWRS Program.

BACKGROUND

High-level radioactive waste (HLW) has been stored in large underground storage tanks since 1944. Approximately 227,000 m^3 (60 Mgal) of waste have been accumulated in 177 tanks. These caustic wastes consist of many different chemicals. The waste forms include liquids, slurries, salt cakes, and sludges. The radioactive waste stored in these tanks has come from various sources: (1) three different plutonium and uranium recovery processes from approximately 100,000 Mtu of irradiated fuel, (2) three different radionuclide recovery processes from waste, and (3) miscellaneous sources (e.g., laboratories and reactor decontamination solutions). The neutralized wastes include sodium nitrate/nitrite, sodium hydroxide, sodium aluminate, sodium phosphate, large amounts of organics, and approximately 260 MCi of radionuclides.

The wastes are stored in 149 single-shell tanks (SST) and 28 double-shell tanks (DST). The SSTs consist of a reinforced concrete tank with a carbon- steel liner and have capacities ranging from 208 m^3 (55,000 gal) to 3,785 m^3 (1 Mgal). The DSTs consist of a carbon-steel tank within a steel-lined concrete tank, each having a nominal capacity of 3,785 m^3 (1 Mgal) as shown in Fig. 1. Of the older SSTs, 67 have leaked or are suspected to have leaked approximately 3,785 m^3 (1 Mgal). No waste has been added to the SSTs since 1980. The pumpable liquids have been removed from many of the SSTs so that the remaining waste is mostly sludge and salt cake. There is no evidence to suspect that any of the newer DSTs, the first was placed in service in 1971, have leaked.

In addition to the waste stored in the tanks, significant amounts of ^{90}Sr and ^{137}Cs were removed from the tank waste, converted to salts, doubly encapsulated in metal containers, and stored in water basins as shown in Fig. 2. There are approximately 1,900, 6.7 cm (2.6 in.) dia x 52 cm (20.5 in.) long capsules containing 160 MCi.

TWRS PROGRAM SCOPE AND PLAN

The TWRS Program includes all activities for receiving, safely storing, maintaining, treating, and packaging for disposal of all highly radioactive tank waste. Tank waste includes the contents of 149 SSTs, 28 DSTs, plus any new waste added to these facilities, and all cesium and strontium capsules currently stored onsite including the return of cesium and strontium capsules from other users. Other highly radioactive materials (such as irradiated fuel) may also be safely stored by the program.

The program scope also includes existing facilities such as waste storage tanks, evaporators, pipelines, and the grout low-level radioactive waste (LLW) treatment and disposal facilities. It includes supporting facilities that make up the total TWRS infrastructure, including upgrades to existing facilities/equipment and the addition of new facilities. Major additions may include facilities to separate and immobilize HLW; safely store feedstocks, interim products, and immobilized HLW; and further treat process generated low-level, transuranic, hazardous, and/or mixed wastes.

Closure (final disposal) of the SST and DST sites, currently is not included in this program. Also, development of a geologic repository for disposal of HLW is the responsibility of DOE's Office of Civilian Radioactive Waste Management.

The current conceptual design for the TWRS is shown in Fig. 3. This concept was based on an environmental impact statement prepared in 1987 (1). A record of decision (2) was issued in 1988 that states:

- The strontium and cesium capsules will be disposed in a geologic repository.

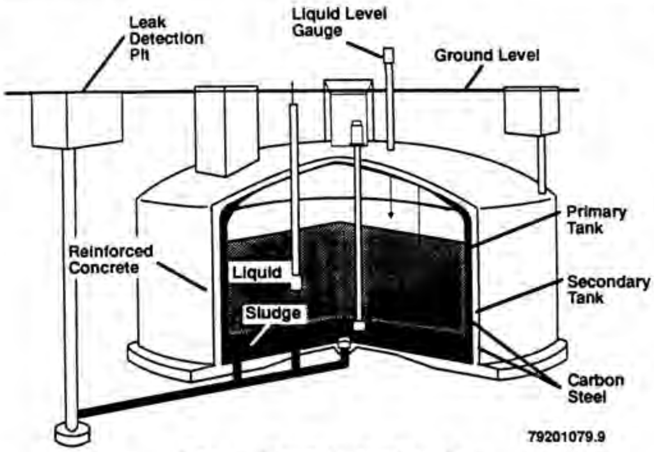

Fig. 1. Double-shell tanks.

- The DST waste will be separated into two fractions, with the high- activity fraction vitrified and disposed in a geologic repository and the low-activity fraction grouted in near-surface disposal vaults.
- The SST waste will undergo additional development and evaluation before a final disposal decision is made.

Since this decision was made in 1988, several assumptions upon which it was based have changed. These include the identification of significant waste tank safety issues; the DOE, U.S. Environmental Protection Agency, and Washington State Department of Ecology signing the Hanford Federal Facility Agreement and Consent Order (3); the elimination of B Plant from consideration as a waste pretreatment facility; and the inclusion of SST waste retrieval. As a result, resolving waste tank safety issues, planning for SST waste retrieval, and developing pretreatment facilities have become major elements of the TWRS Program. With these changes, the program is being reevaluated to determine the best path forward. A new baseline is being developed and a TWRS environmental impact statement is planned.

GOALS AND OBJECTIVES

An initial set of TWRS Program goals and objectives were established in a decision by the Secretary of Energy on December 20, 1991, and have been further refined as the baselining has progressed. Reduction of environmental, safety, and health risks inherent in the Hanford Site tank waste operation and remediation was the primary goal set for the Hanford Site TWRS Program; resolution of outstanding safety issues is the highest priority (4). A systems approach is being used to address the complex and interrelated activities associated with the management and disposal of Hanford Site tank wastes, and solution independent goals and objectives are being developed as shown in Fig. 4.

MANAGEMENT APPROACH

The TWRS will be managed as a Major Systems Acquisition (MSA) following the guidelines established in DOE Order 4700.1A, Project Management System (5). This management system is a proven method for formally establishing scope, cost, and schedule, measuring progress and controlling change of complex activities. DOE Order 4700.1A will be implemented as appropriate to the maturing TWRS Program.

The Hanford Site is also adopting Systems Engineering for TWRS and other cleanup programs. This process will help us to identify the right set of design options, analyze the options in a neutral manner, prepare a defensible decision analysis, and provide the basis for program deployment. To do this, the Hanford Site has had to step back and look at the problem anew, as discussed under Technical Strategy below. This strategy is currently undergoing reevaluation and baselining. A new technical strategy will be ready for discussion with the regulators and others by March 31, 1993. This

Fig. 2. Strontium and Cesium capsules are stored underwater.

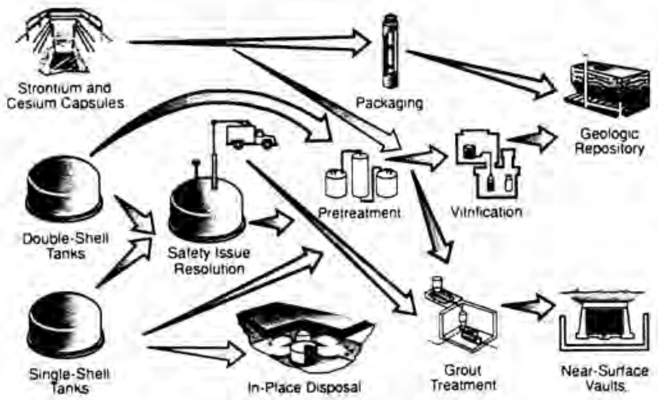

Fig. 3. Hanford site tank waste remediation system.

new technical strategy will be described in four baseline deliverables as follows:

Program Plan

The program plan includes the project charter and is a summary of the dimensions of the program to be executed, including mission, objectives, schedule, resources, priority, controlled milestones, and environmental requirements. For MSAs, the plan is a contract between DOE-Headquarters and the field organization for execution.

Program Management Plan

The program management plan describes the plans, baselines, control and reporting systems, and methodologies to be employed in the management of the program, and defines the organizational relationships, roles, and responsibilities of the program participants. It contains the TWRS Program baseline for measuring work performance.

Functions and Requirements

Functions and requirements describes the necessary functions for completing the mission and identifies the requirements that the functions must satisfy.

Integrated Technology Plan

The integrated technology plan describes the technology planning process that is being used to identify, select, and prioritize technology development activities, and the strategy for developing the technology.

Many of the TWRS Program uncertainties are technical and technology planning has three primary objectives:

- Providing technology in time to support the aggressive Hanford Site cleanup schedule.
- Ensuring the technology will do the job; i.e., developing alternatives where there are technical uncertainties; and ensuring the technologies are robust enough to handle uncertainties in waste composition and program changes.
- Continuing the search for ways to do the mission better, safer, faster, and cheaper.

National Technology Working Groups (TWG) are preparing technology plans to assure the best available technology is considered. These TWGs help identify, select, and prioritize the technology development tasks. Foreign technology also is being evaluated and a series of technical exchanges with other countries have taken place.

TECHNICAL STRATEGY

With the program changes described earlier and the severalfold increase in the amount of waste to be immobilized as a result of planning to retrieve all SST waste, the TWRS Program strategy is being reconsidered. This new look is considering the full range of possibilities for resolving tank safety issues and the retrieval, treatment, and immobilization of waste as shown in Fig. 5. Key technical uncertainties include the following:

- Methods to resolve tank safety issues. Resolution in the existing tanks or in a new processing facility are possibilities.
- Capability to sample and analyze the tank waste. Acceptable costs and schedule to support program needs must be achieved.
- SST waste retrieval system. The system must clean the tanks to the desired level at the desired rate, yet function in tanks that may leak.
- Waste pretreatment processes. Radionuclide separation, organic destruction, and possible destruction of other hazardous waste may be needed. There is a wide range of process possibilities at various stages of development. Cost-benefit tradeoffs, including repository disposal fees, must be made as well as evaluation of emerging technologies.
- Grout formulation and LLW near-surface disposal performance assessments. Other LLW forms with better performance characteristics and lower volume may be preferred.
- HLW immobilization capacity and design. The HLW volume that will require vitrification is greatly influenced by the pretreatment processes selected.

The process to select a new technical strategy includes evaluating a range of alternatives, reducing the number of alternatives to a "short list," and then selecting one. The evaluations utilize engineering data on a number of performance measures and a decision analysis technique that compares alternatives based on different preferences.

CONCLUSION

The Hanford Site TWRS Program is a large, complex, costly program that will take decades to carry out. Acquiring the commitment and funding to conduct this program will require a national consensus that it is necessary and it is being done the best way possible. Therefore, it is important that we seek the best technology and use national expertise in planning and conducting the TWRS Program.

REFERENCES

1. "Final Environmental Impact Statement, Disposal of Hanford Defense High-Level, Transuranic and Tank Waste, Hanford Site, Richland, Washington," DOE/EIS-0113, U.S. Department of Energy (1987).
2. "Federal Register," Vol. 53, pp. 12449-12453, U.S. Department of Energy (1988).
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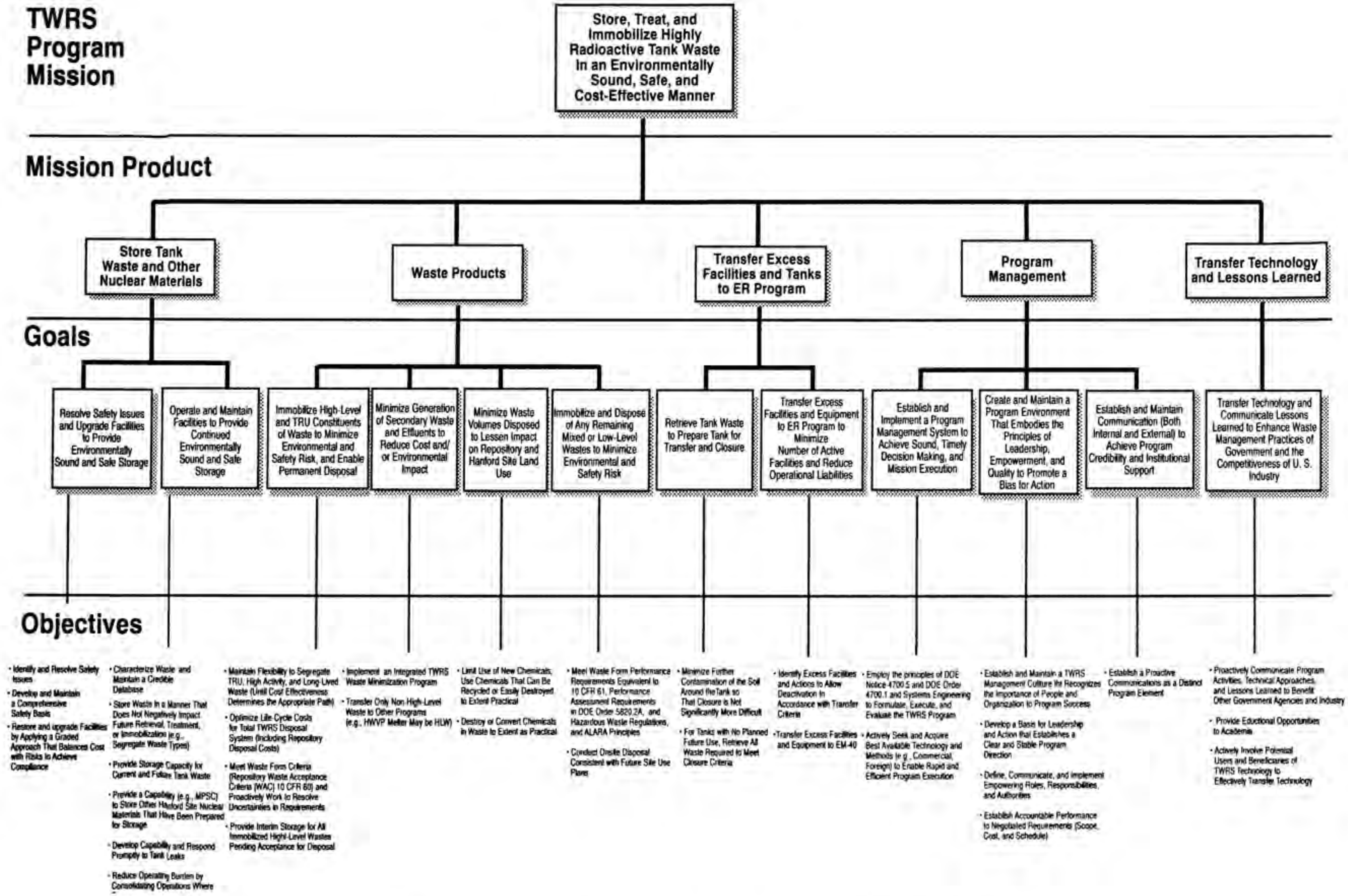

Fig. 4. Tank waste remediation system mission, goals and objectives.

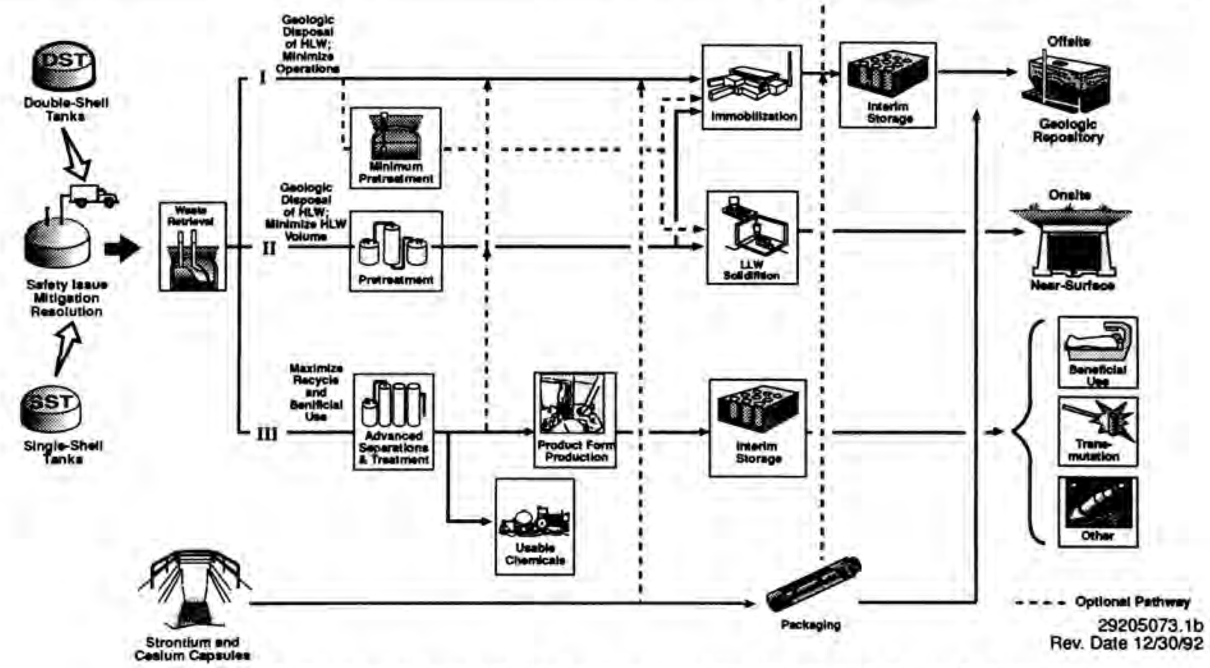

Fig. 5. Tank waste remediation system waste treatment and disposal alternatives.

U.S. Environmental Protection Agency, and U.S. Department of Energy (1989).

4. D.D. WODRICH and J.L. DEICHMAN, "Hanford Site Radioactive Waste Storage Tank Safety Issues: The Path to Resolution," WHC-SA-1328-FP, Rev. 0, Westinghouse Hanford Company (1992).

5. DOE ORDER 4700.1, Project Management System.