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Long Term Decontamination at the Hanford Site: A Case Study

Prepared for the U.S. Department of Energy
Office of Environmental Restoration and
Waste Management

Westinghouse
Hanford Company Richland, Washington

Hanford Operations and Engineering Contractor for the
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DISCLAIMER

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LONG TERM DECONTAMINATION AT THE HANFORD SITE A CASE STUDY

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ABSTRACT

This paper describes an engineering study that evaluates decontamination requirements at Hanford and the potential reutilization of the first plutonium processing production facility as a decontamination facility. The logic used to develop the study, the options available for a long-term decontamination mission, and the resultant strategy recommended in the study are presented. The paper provides a starting point for other similar study efforts. The process flowsheets, regulatory restrictions, and preconceptual designs developed in this study are common throughout the nuclear waste industry.

I. INTRODUCTION

The remediation of DOE Sites over the upcoming years will require extensive decontamination and treatment of contaminated equipment. The goal of decontamination and treatment is to reduce the level of contamination on equipment. This reduces public and occupational risk, lowers disposal costs, or preferably, allows free release of equipment as scrap material. The regulatory drivers of a decontamination program include the requirements for treatment, such as the debris rule, and programmatic issues such as disposal cost, storage constraints, and equipment reuse. Decontamination has been performed for over 20 years at Hanford with the goal of returning equipment to service. Although the long-term restoration mission will not require most equipment to be reused, it is important that equipment removed from waste storage tanks, chemical processing facilities, or generated during environmental remediation activities is treated to reduce its contamination level.

The purpose of the study was to evaluate options for treatment of contaminated equipment and to develop a recommended strategy for a long-term decontamination program. The scope included developing process flowsheets, assessing existing facilities and conditions, quantifying waste characteristics and volumes, and comparing a set of alternatives.

II. WASTE CHARACTERISTICS

The first phase of this study was a determination of the volume and characteristics of contaminated equipment and waste that requires treatment. This was accomplished by using existing databases, evaluating site baseline solid waste forecasts, and interviews with site operations personnel. The following are the results of the waste stream analysis:

- A potential volume of 351,000 cubic meters will require some type of decontamination/treatment over the next 30 years. This waste will contain both high-activity radiological constituents (fission products, alpha and beta contamination) and hazardous waste, including land-ban chemicals.

- Tank farm operations will generate over 100 and up to 1300 pieces of long-length equipment (> 7 feet long) over the next 10 years. Long-length equipment will make up approximately 20% of all contaminated equipment requiring treatment. Seven feet long pieces are considered to be a limiting parameter that is governed by a standard burial box (4' x 4' x 8').

- 65% of the equipment requiring treatment will be contact-handled low-level waste (LLW) and low-level mixed waste (LLMW). The remaining 35% will be remote-handled waste.

- The total throughput requirements vary with time. From FY1995 through FY2005, low volumes of contaminated equipment are expected (between 10 and 25 pieces of equipment per year). From 2005 through 2015, a higher volume of contaminated equipment is expected. After 2015, the volume of equipment will decrease markedly on an annual basis.

III. PROCESS FLOWSHEETS

The first step for preparation of the comprehensive study was the development of a generic process flowsheet. This flowsheet was needed to ensure that a consistent baseline could be used for all options and that the regulatory requirements for treatment were addressed. To accomplish this, a Best Available

Technology (BAT) evaluation approach was used. There are several specific functions required for the decontamination process. These functions included equipment receipt and handling; inspection, sampling and analysis, and assay; size reduction; decontamination; and secondary waste treatment.

Figure 1 provides a box diagram representation of the generic process flowsheet. Each element of this flowsheet was evaluated for its effectiveness, implementability, and cost. These three factors allowed a determination of the best technologies for each step in the process. The key criteria considered in evaluation of treatment methods and alternatives include compliance with debris rule criteria; implementation of ALARA principles; minimization of secondary waste generation; and capital and life cycle cost.

IV. ALTERNATIVE EVALUATION

The four primary alternatives considered feasible to support the Hanford Site's solid waste and equipment treatment needs provide a diverse range of possible scenarios. These alternatives are No Action, T Plant, Other Existing Hanford Facility, and a New Facility.

Alternative 1: No Action

This alternative explores decontamination activities performed in the field, particularly at the location where the equipment is retrieved or initially contaminated. At the Tank Farms, equipment would be decontaminated as it is removed from the tank through either chemical washing or abrasive methods. Another acceptable Debris Rule treatment method is to size reduce long-length equipment after removal and macro-encapsulate using grout or other types of stabilizing/fixation agents. This alternative has a preferential capital cost; however, is the least preferred from a waste minimization and environmental restoration viewpoint.

Alternative 2: T Plant

T Plant has served as a Hanford Site decontamination and equipment repair facility since its decommissioning as a plutonium processing facility 40 years ago. An active program is in place to upgrade the facility and to install decontamination (process) equipment for a long-term mission.

To support the development of this alternative, a detailed assessment of the facility's condition was performed. This assessment evaluated all aspects of the facility including safety systems, structural integrity and seismic qualification, material handling capabilities, utilities, and environmental protection/waste management systems. The assessment evaluated the existing condition of the facility against current regulatory and code requirements. The results of the assessment were used to develop a detailed list of facility upgrades required to support a long-term decontamination mission.

Two scenarios were identified for the T Plant alternative. Scenario 1 establishes the upgrades necessary to provide a limited scope treatment capability based on the processing of long-length equipment. This scenario provides a simplified treatment process for ease of implementation while addressing the upgrades required to make T Plant a viable and compliant material treatment facility. The process scheme includes installation of decontamination modules for equipment size reduction, chemical washing and abrasive decontamination, and waste packaging. Although this scenario is based on long-length contaminated equipment, the process is more than adequate for handling smaller items.

Scenario 2 provides an evaluation of steps necessary to configure T Plant into a full-service facility capable of handling the entire diversity of feed streams site-wide. The basic treatment process schematic resembles that of the first scenario; however, this option includes extensive use of decontamination and waste treatment technologies with emphasis on remote handling through robotics.

Alternative 3: Other Hanford Facility

There are many facilities at Hanford that could be considered for retrofit to meet the long-term decontamination mission. This study evaluated only the canyon facilities in the 200 Areas (PUREX and B Plant) and the Fuels Material Examination Facility (FMEF) in the 400 Area. The use of existing canyon facilities in the 200 Area encounters viability issues similar or more costly than T Plant. The use of the FMEF facility is a feasible alternative since the facility includes substantial shielding, is seismically qualified, has never been used or contaminated, and contains material handling equipment that can be retrofit to support a decontaminated and solid waste treatment mission.

There are two significant disadvantages to using the FMEF facility. The facility is located in the 400 Area; south of a checkpoint known as the Wye Barricade. Hanford's transportation system is exempt from certain federal transportation requirements within this barricade. If the FMEF facility was used for contaminated equipment processing, the containers and transportation methods would require licensing. This would have a significant impact on operations at the site. In addition, over 90% of the contaminated equipment will be generated inside the barricade. The second disadvantage to this alternative is that a new facility would become contaminated from a processing mission and require decontamination. In addition, this facility would be precluded from any further missions for fuels or nuclear material processing.

Alternative 4: New Facility

The final alternative considered for a long-term decontamination mission was the design and construction of a new facility. This alternative provides a pre-conceptual design for two new facility scenarios. Scenario 1 provides a limited capability (modular design) based on the long-length contaminated equipment feed stream mentioned earlier in this paper. Scenario 2 provides a full-service new facility capable of handling the entire diversity, flow rates, and volumes of all projected feed streams (worst case). This full-service facility alternative is able to accommodate all waste categories by utilizing multiple, parallel, remote-handled processing lines and includes extensive waste characterization (assay) capabilities.

V. CONCLUSIONS, RECOMMENDATION, AND UNCERTAINTIES

The engineering study identified a strategic path that, if carried out, would support contaminated equipment treatment missions for both limited and full-scale operations. This strategy is based on the regulatory need to treat "land-ban" wastes and meet debris rule requirements while supporting the environmental restoration and waste management activities. The following are key elements of the proposed strategy:

1) A treatment facility is needed to meet long-length contaminated equipment treatment requirements. Without this capability a significant storage expense will be incurred.

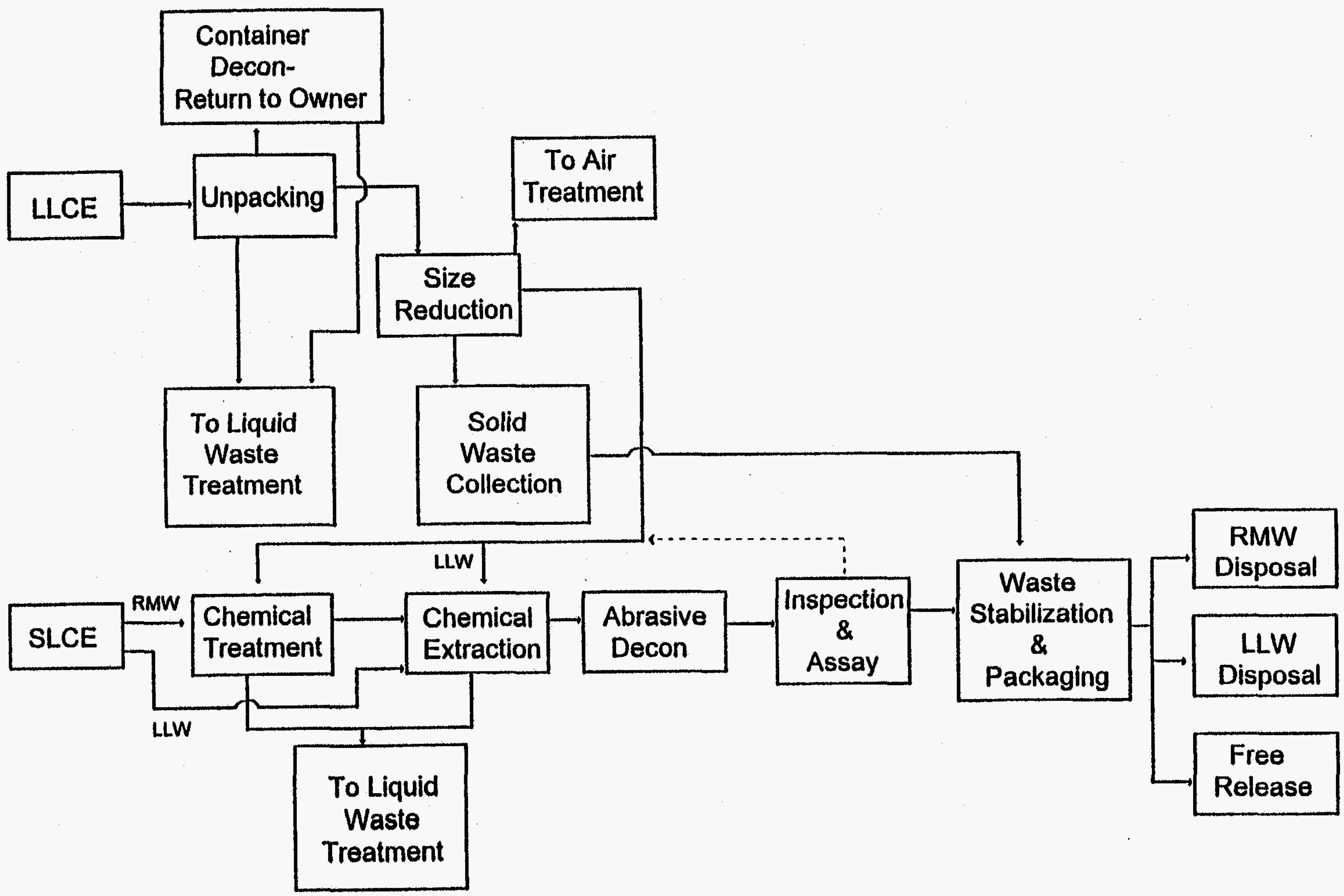
2) The use of T Plant for a decontamination mission is feasible and should be fully evaluated.

3) Throughput limitations at T Plant may eventually force construction of a new facility. The functions of this facility need to be incorporated with the Waste Receiving and Packaging (WRAP) program to ensure the most efficient use of DOE funding.

The uncertainties identified during this study activity affect the results. The key uncertainties include future regulatory and public acceptance of waste burial; the ability to receive funding for new facilities at a site where the primary mission is to remove old nuclear processing plants and equipment; and the volume and type of waste that will be generated. The strategy outlined above must be reevaluated periodically to address these uncertainties.

Figures 2 and 3 show artist renderings of a possible configuration for T Plant and a new facility. The final design for any decontamination facility will require completing life cycle cost analysis, value engineering, systems engineering, and thorough design development through the DOE project management and approval process. The Long-Term Decontamination Engineering Study provides a starting point for this evaluation and project development by providing the site with a strategy upon which it can build.

FIGURE 1: DECONTAMINATION FLOWSHEET



LLCE = Long Length Contaminated Equipment (> 7 FT)
SLCE = Short Length Contaminated Equipment (< 7 FT)

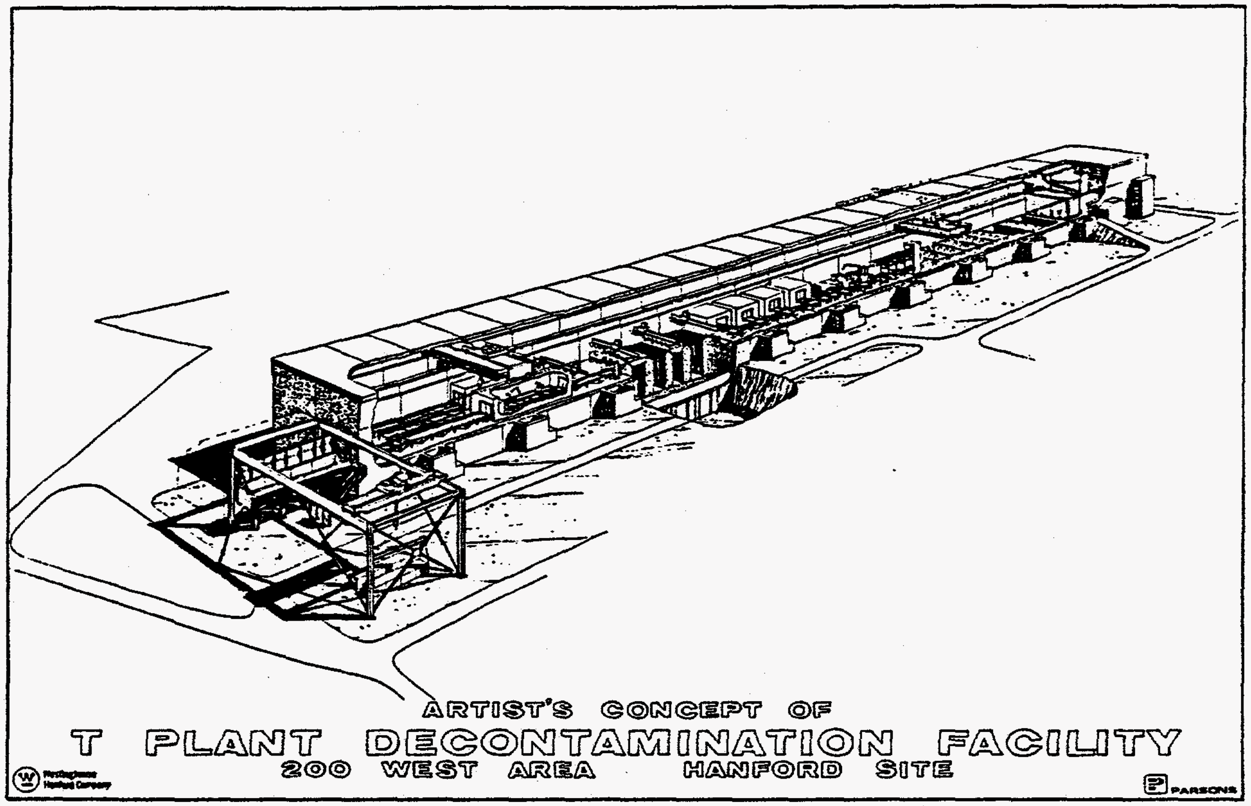


FIGURE 2

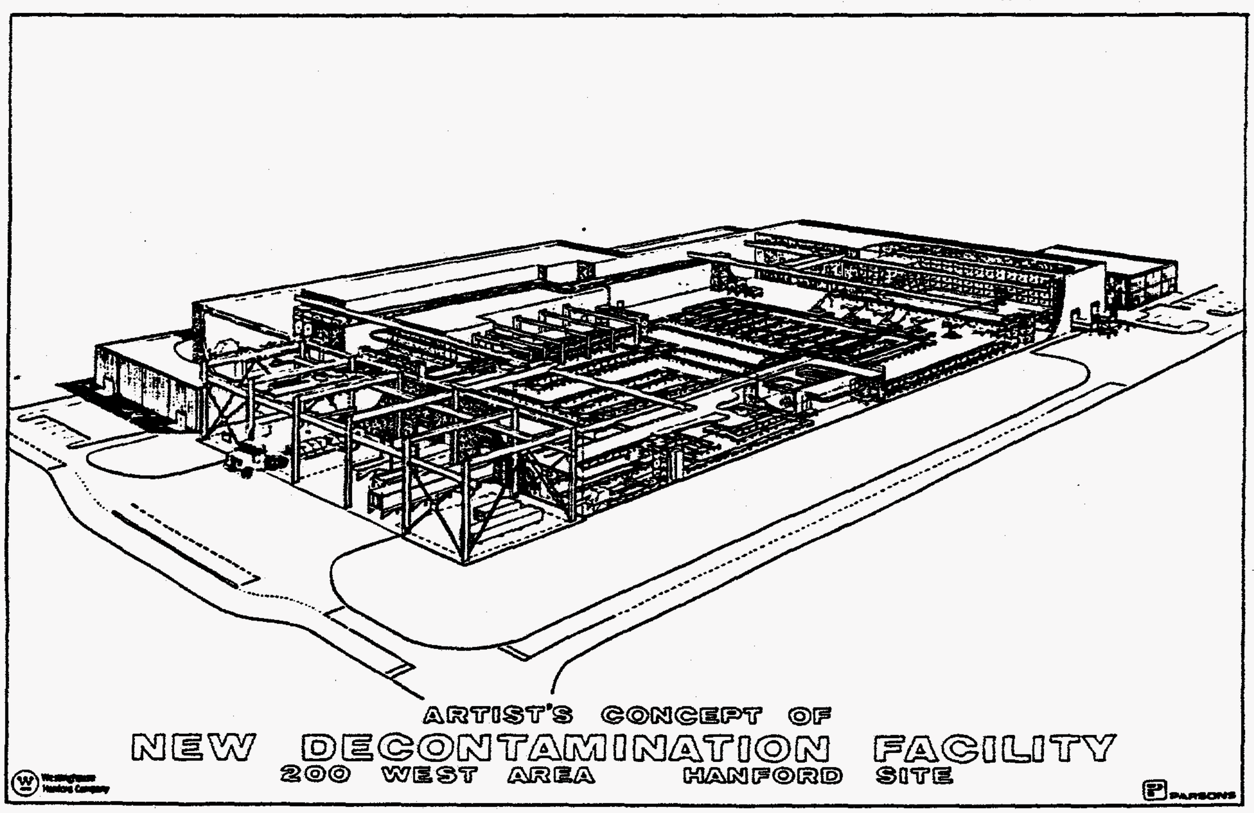


FIGURE 3