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INDEPENDENT TECHNICAL REVIEW OF THE HANFORD TANK FARM OPERATIONS

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CONDUCTED BY THE
U.S. DEPARTMENT OF ENERGY
OFFICE OF ENVIRONMENTAL RESTORATION AND
WASTE MANAGEMENT
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ii. PREFACE

This report documents the findings of an Independent Technical Review of specified aspects of the Hanford Tank Farm Operations conducted by the Department of Energy, Office of Environmental Restoration and Waste Management, at the request of the Assistant Secretary for Environmental Restoration and Waste Management.

Information for the assessment was drawn from documents provided to the Independent Technical Review Team by the Westinghouse Hanford Company, and presentations, discussions, interviews, and tours held at the Hanford Site during the periods November 18 to 22, 1991; April 13 to 17; and April 27 to May 1, 1992.

This is an independent assessment of information known to Hanford Site personnel, some of which is repeated here to support the assessment discussion, and is not meant to imply discovery of the information by the Independent Technical Review Team. However, Independent Technical Review Team members may have assessed the information from a perspective that differs significantly from that of Hanford Site personnel.

A Technical Oversight Board, composed of senior level individuals who have extensive experience in the development, execution, management, and evaluation of large, technically involved projects, is chartered to review all aspects of the activities of the Independent Technical Review Team. The Charter of the Technical Oversight Board directs the Board to review the assessment prepared by the Independent Technical Review Team to assure internal technical consistency and to confirm that the assessment strengths and concerns are supported by sufficient technical information. The Preliminary Assessment Plan for the Hanford Tank Farm Operations review (Appendix H) was presented to the Technical Oversight Board on February 12, 1992, in Atlanta, Georgia. The Technical Oversight Board concurred with the general approach and provided comments which were incorporated into the Preliminary Assessment Plan. The Independent Technical Review Executive Summary, Section I of this report, was reviewed by the Technical Oversight Board at a meeting of Independent Technical Review Team and Technical Oversight Board members on June 9, 1992, in Pittsburgh, Pennsylvania. Independent Technical Review Team members presented background information on, and assessments of, HTFO operations, maintenance, equipment, research & development programs, and management. The Technical Oversight Board and Independent Technical Review Team members participated in a discussion of the Hanford Tank Farm Operations assessment; the meeting culminated in agreement on statements of the strengths and concerns. As a result of this interaction, the assessments presented in the Independent Technical Review Executive Summary represent a consensus of the Technical Oversight Board and the Independent Technical Review Team.

I. EXECUTIVE SUMMARY

I.A. Background

The Independent Technical Assessment of the Hanford Tank Farm Operations was commissioned by the Assistant Secretary for Environmental Restoration and Waste Management on November 1, 1991. The Independent Technical Assessment team conducted on-site interviews and inspections during the following periods: November 18 to 22, 1991; April 13 to 17; and April 27 to May 1, 1992.

Westinghouse Hanford Company is the management and operating contractor for the Department of Energy at the Hanford site. The Hanford Tank Farm Operations consists of 177 underground storage tanks containing 61 million gallons of high-level radioactive mixed wastes from the chemical reprocessing of nuclear fuel. The Tank Farm Operations also includes associated transfer lines, ancillary equipment, and instrumentation.

I.B. Introduction

The Independent Technical Assessment of the Hanford Tank Farm Operations builds upon the prior assessments of the Hanford Waste Vitrification System and the Hanford Site Tank Waste Disposal Strategy.

The objective of this technical assessment was to determine whether an integrated and sound program exists to manage the tank-waste storage and tank-farm operations consistent with the Assistant Secretary for Environmental Restoration and Waste Management's guidance of overall risk minimization.

The scope of this review includes the organization, management, operation, planning, facilities, and mitigation of the safety-concerns of the Hanford Tank Waste Remediation System.

The assessments presented in the body of this report are based on the detailed observations discussed in the appendices. When the assessments use the term "Hanford" as an organizational body it means DOE-RL and Westinghouse Hanford Company as a minimum, and in many instances all of the stake holders for the Hanford site.

I.C. General Assessment

- **The condition of the tank farms is poor and continues to deteriorate further because corrective maintenance is not keeping up with the equipment failure and the tank farm upgrade program is not being implemented fast enough.**

- **Tank safety issues and the deteriorated state of the tank farms have been designated as the highest priority concerns within the DOE complex, yet the majority of the funds reprogrammed to address the tank safety issues have come from tank farm operations rather than the other programs at the Hanford site.**

- **Westinghouse Corporation has not fully accomplished the primary objective of a managing and operating contractor: the implementation of business planning and methods in the operation of a government facility.**

I.D. Major Observations

I.D.1. *The tank-farm equipment and instrumentation are in poor condition and deteriorating.*

- The time required to repair the older equipment (e.g. compressors and blowers) in the tank farm often exceeds nine months.

- About one third of the instrumentation is nonfunctional; the majority of the instrumentation is old, not designed for calibration, and producing output of indeterminate quality.

- It is unlikely that leaks would be immediately detected in any single-shell tanks.

- The lack of an accurate, reliable document infrastructure (for example, technical drawings, equipment specifications, safety equipment lists) prevents an understanding of the hardware and of the control systems.

I.D.2. *The tank farms continue to deteriorate due to a multiplicity of problems, many of which arise from institutional culture.*

- The multiple barriers to change and improvement in the tank farms appear to be primarily imposed by Hanford (USDOE, Westinghouse Hanford Company, unions, supporting contractors, and the long-term workforce). The constraints appear to be rooted in a culture of fiefdoms, crises management, rationalization of existing conditions, and justification of additional resources. Emphasis of the DOE-RL and WHC management teams should be on a change of culture.

- While the Westinghouse Hanford Company needs to make considerable improvement in their business operation (efficient and optimum use of people and budget) a second element necessary for success in the Hanford operations is an improvement in the leadership provided by DOE-RL (clear guidance and prioritization, responsive approval cycles, integration of multiple contractors, coordination of approach to problem solving, and reprogramming of funds to solve emergencies).

- Strict, conservative interpretation of the Department of Energy Orders, rather than thoughtful, graded application, has created artificial barriers to improving tank-farm conditions.

- DOE line management has not provided coordinated guidance concerning the implementation of the many newly revised or issued Orders.

- Integration of activities at Hanford has not occurred. The reprogramming of funds to cope with the unreviewed safety questions of the stored tank wastes has been entirely within the DOE-RLTank Farms Project Office rather than site-wide. The result is a delay in tank farm upgrades which is contrary to risk minimization.

I.D.3. *Emergency response capability for a tank breach is weak because of the poor condition of the tank farm equipment.*

- In the event of a leaking single shell tank, response options that require pumping from the leaking tank(s) could not be carried out expeditiously in most instances. Transfer lines, valves, and pumps are not readily available for emergency response.

- The existing situation (inadequate drawings, out of service instrumentation, inadequate waste characterization, and inadequate tank vapor characterization) necessitates an over-reaction to incidents in order to ensure safety.

I.D.4. *The Operational Safety Requirements are not adequate to provide for the secure storage of the wastes, and there are instances of non-adherence to the Operational Specifications.*

- The Operational Safety Requirements and Operational Specifications are incomplete and out-of-date.

- No corrective action has been taken on a double-shell tank that since 1985 has been below its Operational Specification limit for hydroxide concentration.

- Tank sampling is so limited that in most cases it is unknown if the waste in a tank is within the Operational Specification limit.

- The philosophy of waste tank stewardship at Hanford has historically been inadequate and although currently improving still suffers from the rationalization of existing conditions by a workforce conditioned by the old atttitude.

I.D.5. *The Environmental, Safety, and Quality oversight from Westinghouse Hanford is compliance-based rather than performance-based; it has not been effective in identifying and reversing the years-long trend of continued tank farm deterioration.*

- The Westinghouse Hanford ES&Q organization functions as both an independent oversight body and a matrix support organization to tank farm work activities, thereby creating a conflict of responsibilities.

I.D.6. *The maintenance program is constrained by the following correctable conditions in the tank farms:*

- Absence of creative solutions to solve or reduce the access restrictions and fresh-air breathing equipment requirements for those tank farms having radioactive contamination and the possible presence of hazardous gases;
- Inaccurate drawings of the equipment and instrumentation;
- Excessive review signoffs for job control packages;
- Ineffective safety classification of equipment and lack of a master equipment list;
- Inadequate bases for the preventive maintenance program; and
- Difficulties in coordinating multiple support groups (e.g., safety, crafts, industrial hygiene, operations).
- The observed level of activity at the tank farms is below that required to change the condition of the tank farm, and is inconsistent with the size of the work force or budget for operations and maintenance.

I.D.7. *The Tank Farm Operations does not have a current risk-assessment baseline.*

- Task prioritization is based on subjective or perceived risk reduction instead of formal safety/risk assessments.
- This situation precludes optimum use of the budget and creates a potential for unnecessary exposure of personnel to chemical and radiation hazards.
- Westinghouse Hanford is developing revised risk assessments, and has recently begun establishing the bases for interim operation.

I.D.8. *The limited ability to sample and characterize the tank wastes has been an impediment to many Hanford programs for years and is still a constraint to resolving tank safety issues, obtaining RCRA permits, and planning for the TWRS.*

- The current capability for high level waste analysis is still short of demand, but Westinghouse Hanford is now becoming proactive in managing the shortfall between sample analysis needs and the laboratory capability.

- The expanded operation of the two Hanford analytical laboratories for radioactive sample analysis (Buildings 222S and 325) is critical for the operation and the permitting of all of the Tank Waste Remediation System activities (tank-safety-concern mitigation, evaporator, Liquid Effluent Treatment Facility, grout, pretreatment, and vitrification).

- Until very recently the analytical laboratories have not received the management attention and support commensurate with their importance to the program.

I.D.9. *T Vestinghouse Hanford plans and concep..s for the Tank Waste Remediation System are based on optimistic assumptions regarding the volume of waste to be treated, the schedule for upgrade or construction, and the operating availability of the unit processes.*

- The planning assumes that all of the units (retrieval, pretreatment, evaporator, Liquid Effluent Treatment Facility, grout, and vitrification) will operate in a continuous mode with high availability. Historically, this appears to be a poor assumption.

- The projected need for new waste tanks is very dependent on factors having large uncertainties (waste type and volume to be added to the tank farm and on the efficiency and availability of the evaporator, Liquid Effluent Treatment Facility and the grout disposal). The projections assume optimistic values for these factors and the need for new tanks, a long lead-time procurement, may be underestimated.

- Unless the tank farm upgrade program is . inded and accelerated, the high-visibility projects (cross-site transfer lines and new treatment/storage tanks) may be of limited use because the overall condition of the ancillary equipment is so poor and the diversion boxes, valve pits and intertank lines are not doubly-contained as required by current regulations, thereby restricting their use to "emergencies."

- Westinghouse Hanford has prepared schedules they cannot meet using unrealistic assumptions and milestones provided by DOE. Apparently these plans and schedules serve as the basis from which Westinghouse Hanford and the DOE line management develope a desired budget request.

When the actual budget is significantly below the request levels there are no sound plans and schedules with which to actually operate. The ITR Team found this false planning to be one of the major reasons for worker frustration at the plant.

I.D.10. *The activities to understand some of the safety issues for the watch-list tanks are well founded while programs to address the other safety issues are still being formulated.*

- The program to understand and develop mitigation plans for the tanks that are emitting flammable gases is well founded and proceeding on a realistic schedule.

- The program to address the tanks believed to contain ferrocyanide compounds is not as far along as that of the flammable gases and is on a longer schedule. Mitigation planning is limited, pending the results of waste characterization. This program should be expanded and accelerated.

- The tank safety issues of organic-nitrate compounds, high heat, criticality and toxic vapor emissions are currently receiving only minimal funding. Program managers are in place and programs are being defined. These programs should be expanded and accelerated.

- The coordination of the operations and maintenance activities at the tank farms containing the watch list tanks needs improvement. The Conduct of Operations program should ensure that all operators assigned to these tank farms be familiar with the status of all equipment in these farms.

I.D.11. *Westinghouse Hanford Company has begun to assemble a technically competent and dedicated management team for the Tank Farm Operations.*

- Westinghouse Hanford management has instituted several initiatives that are now improving the Tank Farm Operations.

- The ITR team encountered many Westinghouse Hanford managers and staff who are working diligently to solve the problems of the Tank Waste Operations.

II. SCOPE AND METHOD OF ASSESSMENT

II.A. Scope of Assessment

Westinghouse Hanford Company (WHC) is the principal management and operating contractor for DOE at the Hanford Site. The activities of the the Waste Tank Project and the Tank Waste Safety organizations of the Westinghouse Tank Waste Remediation System (TWRS) were the focus of this independent technical review. These activities are referred to as the Hanford Tank Farm Operations (HTFO). The operation of the Tank Farm, its supporting facilities and efforts to resolve identified tank safety issues were looked at by the Independent Technical Review (ITR) Team.

The TWRS mission with respect to the tank farm is to: "Manage the Hanford Site waste tanks in a safe, efficient, and environmentally responsible manner in compliance with codes, standards, and regulatory requirements. Through evaluation, remediation/mitigation and verification assure that the contents of the 177 underground large underground waste storage tanks are safely stored until they can be disposed of." In addition the TWRS is charged with resolving identified potential safety issues ranging from episodic flammable gas releases to aging facilities.

During the last 40 years, the management and handling of the liquid radioactive waste have focused on reducing the volume of the liquid in underground tanks. This liquid waste reduction strategy has been based on two requirements: (1) the need to provide needed high-level radioactive waste storage capacity to support the nuclear weapons production missions, by either evaporating the water or by chemical treatment; and (2) the need to pump as much drainable liquid as possible from the single shell tanks (SSTs) to minimize the volume of liquid available to leak into the ground. The result is that the 177 underground waste storage tanks at the Hanford Site now contain nearly 226 million liters (60 million gallons) of radioactive liquid, sludge, and saltcake.

Because it was previously assumed that the disposal of the stored waste would be initiated in the 1990's, waste management funding for waste storage upgrades during the last two decades was phased down. Insufficient funding has been available to (1) resolve issues associated with the longer than expected storage of high level radioactive waste or (2) properly maintain and upgrade the waste tanks and waste support facilities.

The facilities and operations of the tank farm are located in the 200 East and 200 West Areas. These areas include 149 SSTs, 28 double shell tanks (DSTs) as well as the tank farm infrastructure including waste transfer facilities such as interconnecting pipelines, pits, and catch tanks; and surveillance systems and support equipment. In addition to the waste tanks, the Waste Tank Project is responsible for operation of one evaporator/crystallizer; one waste unloading facility; and various other support facilities.

To place reasonable bounds on resources (time, personnel, documentation) required for this review, limitations were placed on its scope and duration. It is not practical to continue modifying this report to reflect ongoing changes. However, the strengths and weaknesses presented in the ITR Assessment Summary are viewed as systemic in nature and are generally not dependent on specific process details.

II.B. Method of Assessment

This Independent Technical Review was performed based on the Charter for the ITR HTFO Review Panel (Appendix H), developed and approved by DOE prior to the review of the HTFO.

Based on the HTFO Technical Review Charter and charters established for prior reviews, the purpose of an ITR is to assess whether engineering and management practices are being implemented such that specific major activities can be executed without significant technical problems. The objective of the ITR is to produce a documented, independent, engineering review of major activities funded by DOE-EM and specifically assigned to DOE-Waste Management. Each review provides a factual understanding of the actual situation at the time of the review. The output of the review is a clear articulation of the strengths and weaknesses in the technology and engineering practice, the major uncertainties, and suggestions on beneficial courses of action.

Fig. II-2 outlines the structure of the Independent Engineering Review Organization which is subdivided into two groups, the Independent Review Group and the Technical Oversight Board. The Independent Review Group comprises the technical experts that must examine the details of an activity as the basis for conducting the technical assessment. This Group must develop the thorough understanding of the activity and the factors and conditions that are important to its eventual success. The Technical Oversight Board is composed of senior level individuals who have extensive experience in the development, execution, management and evaluation of large and technically involved projects. They provide a solid reference point of experience and ideas against which the Independent Review Group can test its ideas regarding line of inquiry and the logic and validity of findings and conclusion.

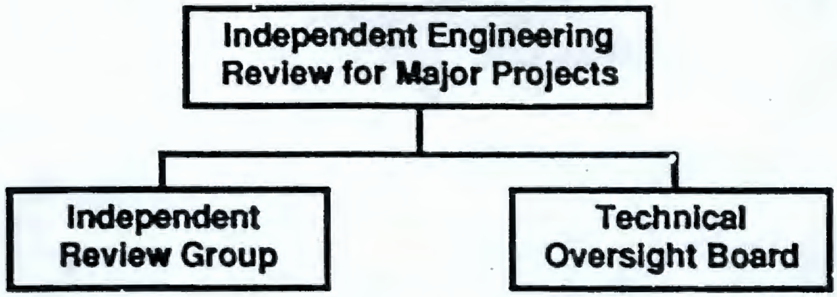

Fig. II-2. Independent Engineering Review Organization

The HTFO Independent Engineering Review was carried out in a fashion similar to the review of the Hanford Waste Vitrification Plant (HWVP) which took place in the Summer of 1991 and the recent review of the Defense Waste Processing Facility (DWPF). Team members were employees of various organizations including: Los Alamos National Laboratory, Sandia National Laboratory, Oak Ridge National Laboratory, SAIC, Inc., Wastren Inc., H&R Technical Associates, Nuclear Systems Associates, Inc., and private consultants. The complete team consisted of 25 technical and two support personnel. Resumes of the HTFO ITR Team members are provided in Appendix K, as is a listing of the TOB membership.

The on-site review process consisted of document review, formal presentations by WHC and DOE/RL, and informal group and individual discussions with WHC, PNL and DOE/RL personnel, tours and equipment inspections. Presentations, discussions, tours and equipment inspections were held at the Hanford Site during the weeks of April 13-17 and April 27- May 1, 1992. During the first week at the site, the Review Team listened to formal presentations given by WHC personnel, and gathered information. The second week of the review was spent in small group discussions with WHC personnel on specific topics. During the week of May 4-8, 1992 members of the Review Team met at Los Alamos to prepare a draft of the ITR Assessment Summary of this report. The Draft ITR Assessment Summary was presented to the TOB on June 9, 1992

The ITRTeam worked in parallel with a DOE-Headquarters Conduct of Operations/Maintenance Review Team. The two teams had separate charters but shared information and worked together as appropriate. The report of the Conduct of Operations/Maintenance Review Team was issued separately.

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III. GENERAL TECHNICAL ASSESSMENT

III.A.1. The tank-farm equipment and instrumentation are in poor condition and deteriorating [I.D.1].

The tank farm equipment includes the tanks, diversion boxes, valve boxes, valves, catch tanks, interconnecting pipelines, pumps, compressors, ventilation systems, electrical distribution system, and instrumentation systems. The time to repair the older failed equipment often exceeds nine months. Most of this equipment is at the end of its service life.

The lack of an accurate, reliable document infrastructure (such as technical drawings, equipment specifications, safety equipment lists) is a real barrier to understanding the hardware and the control systems. The tank-farm drawing upgrade program was reduced by 20 percent in 1992. At its present rate, the program to update the Essential and Support drawings will take about seven years. The safety equipment lists are being developed in concert with the Safety Analysis Report (SAR) revisions. Safety analyses and risk assessments are needed to support the safety equipment lists. A safety equipment list is to be developed this year in conjunction with the double-shell tank (DST) Interim Operational Safety Requirement (OSR), but the complete revision of the tank farm SARs will not be finished until 1996. Such long development times for the design basis documentation are impeding the turnaround in the condition of the tank farm.

The waste levels are monitored by three types of instruments—a radar instrument (in tank 241-SY-101 only), FIC gauges (an automatic conductivity probe), and manually-operated conductivity probes. In April, 1992, 36 of 109 FIC gauges were reported as failed, including 10 that monitor the levels in Watch List tanks. Thirty-three of the thirty-six failed gauges had been out of service for more than three months. The inability to take waste level readings has resulted in multiple instances of Operational Specifications non conformance.

In addition to waste level measurements, six other types of systems are utilized to detect tank leaks . Some tanks have multiple means of leakage detection whereas others depend on one type. The team received conflicting information on the status of the leak-detection systems. Most of the drywells are still in service, but the ability to detect a leak depends on the size of the leak and on the extent of the existing ground contamination. All the laterals (horizontal dry wells underneath 15 SSTs) are now out of service. The annulus air monitoring system on DST 241-SY-101, one of two different types of leak detection system for the DSTs, was out of service for two months. A significant fraction of the annulus air monitoring systems on other DSTs have been out of service for months at a time.

Thermocouple readings are acquired manually and by two automated systems (two other automated systems are under development). Each system is administered by a different group of people within the Tank Farm Operations. Over 3000 thermocouples are located in the tank farms although a significant fraction of the SST thermocouples were cut during the 1970s as part of the waste tank stabilization and isolation project. The team found it very difficult to determine the status of the temperature-monitoring system and received conflicting information. For example, a presentation to the Defense Nuclear Facilities Safety Board (DNFSB) in January, 1992, noted that 33% of all thermocouples were not working and thermocouples were inoperable in 42 of 177 tanks. On April 28, 1992, the Computer Automated Surveillance System (CASS) could receive data on only 111 thermocouples. There are 2526 thermocouples recorded in the CASS but many of those are read and the data entered manually. Those thermocouples that are read manually are classified as inoperative if the reading differs by more than a few degrees from what is expected, completely nullifying their value in the program to monitor for "hot spots" in the tanks. The complete program for monitoring temperature must be reconstituted on a firm basis of safety and of plant operation. The revised program must take into account thermocouple calibration (the existing thermocouples were not designed to be calibrated), achievable accuracy, and expected lifetime (corrosion can affect the junction zone and the temperature readings before the thermocouple actually fails).

Air compressors are used at the tank farms for process applications and instrument air. There are 37 compressors in 26 facilities; 14 compressors (38 %) are currently inoperable and the average time for repair/replacement is 9 months. The deteriorating air piping system is leaking, in one instance requiring an air supply from a 75 hp compressor whereby a 5 hp compressor should meet the need.

The transfer lines, diversion boxes, and valve boxes are of the same vintage as the tank farms they serve. There have been few upgrades. Therefore, most of the piping infrastructure does not meet the current double containment standards of the DOE and the State of Washington. The planned piping and valve box upgrades will not establish doubly-contained interconnections among all the tank farms.

The tradition of the tank farms is to repair rather than replace, presumably an attitude established when tank farm organizations received small budgets. For example, a data logger for the CASS had been out of service for two months. After the manufacturer informed Westinghouse Hanford Company (WHC) that the data logger was too old to repair, the repair was attempted in house. Similarly, an effort to rehabilitate the original thermocouples in 22 ferrocyanide tanks took almost 2 years at a cost of at least several hundred thousand dollars; after considerable expense of time and money, the tanks are still monitored by 40-year-old instruments that produce data of indeterminate quality.

III.A.2. <u>The tank farms continue to deteriorate due to a multiplicity of problems, many of which arise from institutional culture</u> [I.D.2].

The multiple barriers to change and improvement in the tank farms appear to be primarily imposed by Hanford (USDOE, Westinghouse Hanford Company, unions, supporting contractors, and the long-term workforce). The constraints appear to be rooted in a culture of fiefdoms, crises management, rationalization of existing conditions, and justification of additional resources. Emphasis of the DOE-RL and WHC management teams should be on a change of this culture. Westinghouse Corporation must provide the business methods typical of industry and DOE-RL must provide the leadership.

Maximum application and strict interpretation of DOE orders, rather than thoughtful, graded application, has created artificial barriers to improving tank-farm conditions and resulted in an increase of the maintenance activities backlog. The safety classification of components is a primary example. For systems that have been interim-classified as safety class, the engineering organization has decreed that all parts of that system must be assigned the same classification (the procedure allows an option but engineering has not permitted exceptions), even if the part itself performs no safety function and its failure would not prevent the overall system from performing its safety function. The philosophy of piecemeal upgrade of systems to the interim-safety classification ignores the fact that in most cases the entire system can never be completely qualified. The extensive delays in trying to qualify individual components is creating a safety problem. The tank-farm maintenance operation needs an approved policy that allows repairs maintenance activities to use commercial-grade replacement parts (equivalent to those being replaced) rather than safety-grade components if failure of the commercial- grade component would not create a more serious safety problem than one caused by having the component out of service. Although the WHC-SD-WM-PLN-014 procedure permitted such repairs, an employee raised concern and because there was no approval for this practice from DOE, the WHC-SD-WM-PLN-028 procedure requiring safety-grade replacement parts was implemented. A second example of maximum application of a DOE Order is that the implementation plan for DOE Order 5480.19, Conduct of Operations, is based on full application even though the order permits a graded approach. Two reasons were given for not taking the graded approach: (1) WHC wanted to demonstrate through conduct of operations that it could run an exemplary facility, and (2) WHC did not believe DOE would approve a graded approach. WHC has recently instituted a graded approach to the analytical characterization of waste samples.

DOE line management has not provided coordinated guidance concerning the implementation of the newly revised or issued orders. DOE-RL and DOE-EM have not established guidelines for the format and content of the documentation of compliance (matrix) required by 5480.19 and the more general implementation plans for the new 5480 series orders required by Paragraph 8.d(6) of DOE Order 5480.1B, "Environment, Safety, and Health program for Department of Energy Operations." DOE-RL does not have a structure, documenteu review and approval process for such implementation plans, including (1) assignment of responsibility (what can the Site Representative approve, what requires DOE-RL Manager approval, what requires specific levels of DOE Headquarters approval); (2) the approach for review and approval of minor and major changes to implementation plans (including those resulting from reprogramming of funds); (3) acceptance criteria; and (4) guidelines for the time allotted for the preparation and review of implementation plans for each new DOE 5480 series order that does not contain a specific, mandatory implementation of schedule. Team members who have had extensive experience in the commercial nuclear power industry commented that WHC does not know how to be a regulated party, and that DOE does not know how to be both a regulator and a regulated party, roles that are now required.

Integration of activities at the Hanford site has not occurred. Although this is true in many aspects, the reprogramming of funds to cope with the unreviewed safety questions (USQs) of the stored tank wastes is the aspect with the most implications for risk minimization. The reprogramming of funds to deal with the USQs has been entirely within the DOE-RL Tank Farms Project Office rather than site-wide, resulting in a delay in tank farm upgrades, which is contrary to risk minimization.

III.A.3 Emergency response capability for a tank breach is weak because of the poor condition of the tank farm equipment [I.D.3].

The limitations and out-of-service condition of the instrumentation that is available to detect a leak in the tanks were discussed in Section III.A.1. In many cases, a single-shell tank (SST) could begin leaking without being immediately detected. Forty-four SSTs have not been stabilized (free liquid removed) and the tanks that have been stabilized still contain interstitial liquid that could leak. The ability to pump the remaining liquid out of a tank that begins to leak varies with the location of the tank farm. Although two submersibles, two jet transfer pumps, and a portable pump trailer are currently available to remove liquid from a tank in case of a leak, the limited availability of transfer lines is a problem. Not only would the singly-contained lines have to be tested before use but also the tank contents would have to be sampled before transfer to ensure compatibility with the host tank. Transfer from 200 West area to 200 East area (where most of the spare tank capacity resides) would be even more problematic. For tanks having no viable underground transfer line, an above-ground line would have to be fabricated. Currently, no SAR addresses this possibility and the SAR revision to support this option is 18 months from scheduled completion. The piping for the above- ground option will not be fabricated until the SAR revision is prepared and approved. A report was published in March, 1991, detailing how the transfer from each tank would be accomplished. Operations personnel interviewed thought that the plan was too optimistic and that it might take up to six months to remove the free liquid from a leaking SST.

The existing documentation of the tank-farm support facilities, ancillary equipment and instrumentation is recognized to be deficient, and WHC has programs to correct the deficiencies. Presently, it is conceivable that, in an emergency, proper actions would rely solely on the knowledge of one or two operators rather than on proper documentation of the facilities. The upgrading efforts for safety-related instrumentation and support facilities should continue to be high priority.

During January, 1992, workers in the tank farm reported an exposure to noxious gases. The WHC and DOE response was immediate and extensive. The result was a significant disruption of work that lasted several weeks because the existing knowledge of the kinds of gases generated by the tanks was insufficient to warrant a graded approach to the occurrence. The disruption was prolonged by lack of installed instrumentation to characterize the event in real time and by a delay in obtaining the instrumentation needed for a sufficiently sophisticated post-incident investigation. The exposure was eventually traced to a battery in a mobile unit upwind of the workers that had leaked because of overcharging. The substandard condition of the tank-farm infrastructure, including design basis documentation and instrumentation, will result in continued over-reaction to occurrences to ensure worker safety.

III.A.4 The Operational Safety Requirements are not adequate to provide for the safe storage of the wastes, and there are instances of non-adherence to the Operational Specifications [I.D.4].

The Operational Safety Requirements and Operational Specifications are incomplete and out-of-date.

The Operational Specification Documents (OSDs) contain specifications limiting the concentration of chemical species in the waste. The material tests from which these specifications were developed included only base metal, not test coupons with welds, the most likely point of corrosion. The synthetic solutions used for the tests did not include all of the anions potentially found in the waste streams. In particular, it did not include chloride, a relatively corrosive anion. The issue of chloride content has important implications for the long term durability of the DSTs. This is because the stabilization program for the SSTs is suspected of concentrating chloride in the supernate that is stored in the DSTs.

The OSDs do not require a routine sampling program to ensure that the tanks are within compositional requirements. The limited sampling that has been performed has shown several tanks with chloride levels significantly above the limits established for the waste tanks at the Savannah River Plant (SRP). The limited sampling has also shown that the DSTs 241-AN-102 and 241-AN-107 are consuming hydroxide. Tank 241-AN-107 has been below the required hydroxide level for over seven years. The chemical condition of this tank is adequate to initiate a corrosion sequence.

The philosophy of waste tank stewardship at Hanford has historically been inadequate and although currently improving still suffers from the rationalization of existing conditions by a workforce conditioned by the old attitudes.

III.A.5 **The Environmental, Safety, Health and Quality oversight from Westinghouse Hanford is compliance based rather than performance based; it has not been effective in identifying and reversing the years long trend of continued tank farm deterioration** [I.D.5].

WHC has a very large Environmental, Safety, Health and Quality (ESH&Q) organization, including many on site representatives. A common perception prevails among Tank Farm management that the WHC ESH&Q groups are compliance- (or paper-) oriented rather than performance based, and this view was supported by the observations made by the ITR Team.

One of the primary roles of the QA function with the ESH&Q organization should be the identification of major problems to the president of WHC. Although aware of the increasing percentage of out-of-service equipment in the tank farm, lower level WHC ESH&Q managers had not identified this issue as a source of increased operational risk to the senior management. After the deteriorating condition of the tank farm was brought to their attention by the ITR Team, ESH&Q senior management took aggressive action to remove a major hurdle (safety classification of equipment) that was delaying work-package preparation and repair parts procurement.

The ESH&Q organization is attempting to be both an independent oversight body and a matrix support organization to tank farm work activities. The matrix support functions provided by ESH&Q include health physicists, industrial hygienists, QA review of JCS work packages, QA review of procurement requests, and inspections of maintenance repairs and system performance testing. These activities compromise the primary purpose of an independent oversight group.

III.A.6 **The maintenance program is constrained by the following correctable conditions in the tank farms** [I.D.6].

The low work productivity in the tank farms is a major problem. During tank farm inspections and while driving past the tank farms, the ITR noticed that almost no activity was in progress. The observed level of activity is below that required to change the condition of the tank farm , and is not consistent with the size of the work force or budget for operations and maintenance.

Poor working conditions in the tank farms are one source of low productivity. Physical conditions include radioactive contamination, low radiation fields, and potential exposure to incompletely characterized noxious fumes from the tank vents. All of these hazards can be mitigated and WHC is to be commended for carrying out projects to reduce the contamination and radiation fields in some of the tank farms. Creative solutions are needed to mitigate the exposure to radioactivity and the noxious vapor problem. These solutions might include portable work rooms with controlled ventilation, prefabricated modular replacements for the current tank ventilation systems, higher ventilation discharge stacks for existing ventilation systems, localized shielding curtains, fixed or portable lighting to allow night work, and job site telephones.

In addition to the plant related or facility related reasons for low work productivity in the tank farms, many institutional problems exist, some of which were discussed in Sections III.A.1 and III.A.2. Other barriers include the large team of people from different organizations required to carry out any work in the tank farm. If a member does not appear or decides to leave, the work activity will close down. No single foreman has jurisdiction over all organizations and crafts present. If the work package doesn't agree with the as-found conditions, the job activity must be stopped and the work package put back into the system for revision.

III.A.7 The Tank Farm Operations does not have a current risk-assessment baseline [I.D.7].

Current TWRS prioritization and planning is not based on formal safety-risk assessments, which appears to be true for the Hanford site as a whole. Whether resources are applied to the most important work is impossible to assess. In the past WHC's local reprioritization of work in response to changing requirements (self-imposed and external) was often started without the knowledge of DOE-RL, thus placing DOE in the position of assuming unknown levels of risk. The ITR team is aware that DOE-RL is making progress in working closely with WHC as work needs to be redirected and rescheduled. Also WHC is now addressing the lack of a formal risk-assessment baseline with an SAR upgrade program and an establishment of an interim safety envelope.

Approximately 17 obsolete SARs cover the tank farms. WHC has many activities underway that will eventually lead to risk assessments for the tank farms, to revised OSRs, to revised essential and support drawing, to safety equipment classifications, and to new SARs. ll these activities are interdependent and the extended schedule for the drawing upgrades will delay the entire design basis documentation upgrade program.

WHC has begun a program to address the bases for interim operation until formal documentation is in place. The interim effort is called the Tank Farm Safety Documentation program. The purposes of the program are to establish a defensible Interim Safety Envelope for normal and routine operations, and to establish a current safety analysis that meets emerging requirements and sets a working Operating Safety Envelope. The program includes a multiphase Safety Equipment List development strategy. An interim OSR for DSTs is being developed and transmittal to DOE-RL is planned for June 30, 1992. Implementation will commence as soon as DOE-RL gives approval to the OSR. A Safety Equipment List for DSTs is to be prepared this year in conjunction with the DST Interim OSR, both of which will be incorporated into the SAR during 1993 and 1994. The OSRs for SSTs and the Aging Waste Facility have not yet been started, but lists of OSR topics are to be generated by September 30, 1992. Interim OSRs are to be drafted and reviewed in FY 93.

III.A.8 The limited ability to sample and characterize the tank wastes has been an impediment to many Hanford programs for years and is still a constraint to resolving tank safety issues, obtain RCRA permits, and planning for the TWRS [I.D.8].

Until recently Hanford has had very limited capability to sample the waste tanks and analyze the samples, particularly anything but the top liquid level. The limited sampling capability has created uncertainties in all of the tank waste management and remediation programs, including normal operations, tank safety, Hanford Waste Vitrification Plant, grout, and pretreatment. The effect of these uncertainties cannot be overemphasized, and it is likely that they have translated into years of schedule delay and inefficient program activities. The ITR Team sought to determine whether the planning for sampling and analysis is currently realistic and consistent with programmatic risk minimization. The projection of analytical need and analytical capability is a very complex issue with many variables. The following assessment attempts to explain the major issues.

WHC recently released the Integrated Sampling and Analysis Plan, For Sampies Measuring >10 mrem/hour, WHC -EP-0533, March, 1992. The integration of the sampling needs is a step in the right direction because it attempts to quantify the demands on the laboratory facilities. However, the emphasis remains on meeting the demands of the current project schedules and does not account for new needs that might be identified (such as decontamination and decommissioning of the chemical process canyons and the Hanford production reactors), nor does it allow for accelerating the analysis to enable the acquisition of needed information earlier than called for on the basis of current planning. (It should be noted that the analytical schedules developed for projects were based not on when the infonnation would be needed, but rather on when it could be obtained, given the constraints of inadequate analytical laboratory capacity.)

WHC has recently become proactive in managing the analytical shortfall, sending 99 percent of all environmental protocol samples with activity of less than 10 mrem/hour to off-site laboratories. Sampling and analytical requests are being reviewed to see if needs can be combined or if the data requirements can be reduced and still meet the purpose of the sample. Although the addition of another sampling truck has removed sampling as the constraining function, many opportunities for improvement remain. For example, there is no trained backup for a chemist who is running some of the more sophisticated analytical equipment; and data package preparation and handling has not yet been automated.

Current projections show a shortfall until approximately 1998 when capability is projected to exceed demand. The sampling and analytical projections are based on many assumptions. One of the most important assumptions is that the laboratories upgrade programs will continue on schedule. The 325 laboratory is under the control of Battelle Pacific Northwest Laboratory (PNL) and it must receive adequate operating funds in addition to the facility and equipment upgrades planned. In carrying out the analytical program, PNL has often been underfunded. In May, after the ITR Team made its site visits, the analytical laboratories had to severely constrain operations because they could not transfer their wastes to the tank farm. The ban on waste transfer was due to criticality concerns in the tank farms, but the details show this to be another instance of throwing up an artificial barrier and not seeking immediate relief.

The effects of a shortfall in sampling and analysis are felt by the regulatory issues. The Regulatory subpanel of the ITR found that lack of adequate data on the composition of waste in the tanks is delaying the completion of RCRA Part B permits for the tank farms and grout facility; and characterization data is needed to satisfy Tri-party milestones M-01, M-03, M-10, and M-20. At the present time, the capacity of the analytical laboratory to test radioactive and mixed wastes having radiation greater than 10 mrem/hr is not sufficient at Hanford to meet the demands of the multiple programs. As a result, operations permits for the tank farms or for the grout facility cannot be issued by WDOE because WDOE does not have adequate data to establish permit conditions for operation of the facilities.

WHC management needs to recognize sampling and analysis as a critical path issue. If the time lines are optimistic (or unrealistic), improper prioritization of resources can result. If a milestone cannot be realistically met, planning should address that fact and develop an alternate plan.

III.A.9 <u>The Westinghouse Hanford plans and concepts for the Tank Waste Remediation System are based on optimistic assumptions regarding the volume of waste to be treated, the schedule for upgrade or construction, and the operating availability of the unit process</u> [I.D.9].

Several members of the ITR have had petro-chemical experience and have never worked previously with any DOE facilities. They observed that Hanford operations and planning lack a commitment to achieving an objective. This is particularly true when very optimistic future plans are made in the midst of missed milestones and the collapse of operating ability. In a general sense, the planning has little contingency. For example, the planning for the Tank Waste Remediation System (TWRS) assumes that all of the units (retrieval, pretreatment, evaporator, Liquid Effluent Treatment Facility (LETF), grout, and vitrification) will operate in a coordinated serial mode with high availability, which appears to be a poor assumption, historically. Very little planned redundancy exists; and surge-tank capacity is insufficient. Both features are necessary to raise the availability of the TWRS unit operations. An overly simplistic example emphasizes the importance of this point. Assume that the TWRS unit operations are retrieval, pretreatment, evaporator, grout, LETF, and vitrification, and that these operations are interconnected so that the waste remediation process is halted if one of the operations can not be executed (very nearly the planning case). The total system availability is then the product of the individual unit availabilities. If each unit availability is 75%, the system availability is 18%. If each unit availability is 50%, the system availability is 1.6 %.

The projections of new tank requirements is very dependent on assumptions for waste volume and waste type to be added to the tank farm and the efficiency and availability of the downstream units (evaporator, LETF, and the grout disposal), and the ITR Team received the impression that the assumptions are overly optimistic. There is definitely a large uncertainty factor in these waste projections.

Unless the tank farm upgrade program is expanded and accelerated, the high-visibility projects (cross-site transfer lines and new treatment/storage tanks) may be of limited use because the overall condition of the ancillary equipment is so poor and the diversion boxes, valve pits and intertank lines are not doubly-contained as required by current regulations, thereby restricting their use to "emergencies."

Westinghouse Hanford has prepared schedules they cannot meet using unrealistic assumptions and milestones provided by DOE. Apparently these plans and schedules serve as the basis from which WHC and the DOE line management develop a desired budget request. When the actual budget is significantly below the request levels there are no sound plans and schedules with which to actually operate. The ITR Team found this false planning to be one of the major reasons for worker frustration at the plant.

III.A.10. The activities to understand some of the safety issues for the watch-list tanks are well founded while programs to address the other safety issues are still being formulated [I.D.10].

The program to address the flammable gas burping in DST 241-SY-101, as well as smaller releases in 22 other tanks, is broadly based and has involved the expertise of universities and national laboratories. The composition of the evolved gases has been well characterized and progress is being made in duplicating and understanding the compounds formed by the radiolytic decomposition of the organics in the tank. The simulant studies have not yet addressed all of the possible total organic carbon present in the waste and have not duplicated the $H_2/N_2O/N_2$ ratio found in the tank releases, but the progress is good. The mechanics of the periodic gas release are understood reasonably well. Although the team received presentations on the proposed mitigation measures, it did not pass judgment on their efficacy.

The program for resolution of the ferrocyanide issue is on a longer schedule than that of the hydrogen evolution, and other than keeping liquid in the tanks, the mitigation planning is largely dependent on more characterization data. The activity of this program will be increased in FY93. Twenty-four waste tanks are known to contain some quantity of ferrocyanide. The safety concern is that the metallic-cyanide compounds could react exothermically with the oxidizers sodium nitrate and sodium nitrite. The historical record contains information on ferrocyanides, but the information is not sufficiently accurate for safety considerations. The program to understand this safety issue is based on simulant studies and characterization of the tank wastes. The amount of cyanide is difficult to quantify and presently there are limited core samples available. A field test consisting of sluicing a liquid observation well into the waste and measuring the ^{137}Cs activity with a probe in the well has not detected the concentrations indicative of a cesium cyanide precipitation layer. Although some concerns exist about the dilution caused by the hydraulic sluicing of the well pipe, the team believes that lack of a cesium cyanide precipitation layer may indicate that a metathesis of the cyanide has occurred, which, if true, would essentially preclude any safety concerns. WHC plans to include the possibility of metathesis in their further research into the ferrocyanide issue. The adiabatic calorimeter should also be used when making thermal response measurements for ferrocyanide samples.

The program to understand and develop mitigation methods for the organic-nitrate concerns in the waste tanks is just beginning. This program should be accelerated and funded as necessary. A wide range of organic compounds were added to the waste streams during processing. The high concentrations of the oxidizers sodium nitrate and sodium nitrite (radiolysis and dissolver additive) resulted from the neutralization step when sodium hydroxide was added to the nitric acid waste solutions. Radiolysis has converted most of the original compounds to a very complex reaction mixture. Historical records do not appear to be accurate enough to identify and quantify the organic compounds added to the waste tanks or to identify all of the tanks having this potential problem. The safety concern is that an organic compound could react exothermically with the oxidizers. Core-characterization data are essential to help define the concentrations of the organics, oxidizers, and diluents (such as water and inert salts) in the waste tanks. Sample retrieval and characterization is a priority item. Thermal response measurements are being made on simulants and are planned for waste samples. The team recommends the use of an adiabatic calorimeter to independently confirm the measurements made with the differential scanning calorimeter, including measurements of actual radioactive samples.

The tanks safety issues of high heat, criticality, and toxic vapor emissions are currently receiving only minimal funding. Program managers are in place and programs are being defined. These programs should be expanded and accelerated.

The ITR Team is concerned with an indication that Conduct of Operations in the tank farms having safety issues is weak. Maintenance and operations are not coordinated as demonstrated by the difficulty that the ITR Team had in establishing the nature of a maintenance tag on the exhaust fan of DST 241-SY-101. The questions to WHC about the tag resulted in erroneous reports and then took over a week and the direct involvement of DOE-RL personnel to get the correct information.

III.A.11 Westinghouse Hanford Company has begun to assemble a technically competent and dedicated management team for the Tank Farm Operations [I.D.11].

Most WHC managers have had experience in structured, disciplined organizations where nuclear safety standards and codes were applied. Senior Tank Farm management has expressed a vision of where they want the tank farm to be in 10 years. However, essentially all of the managers we interviewed had been in their positions for less than 18 months. The managers recognized many, if not all, the conditions required for a well-run tank farm. However, the subpanel perceived that their general solution to the problem areas is to obtain more funding and more personnel.

In addition to the assignment of a large number of apparently competent managers to the tank farm, the subpanel found other indications that top-level managers of DOE-RL and WHC recognize the need to address the poor condition of the tank farm. The Westinghouse Corporate Productivity Improvement Center were brought in to identify problems with the tank-farm maintenance activities. A second effort commissioned by DOE-RL and WHC senior management established a task group of about 10 people from DOE-RL and WHC to determine the barriers to accomplishing work in the tank farms and to recommend methods to overcome the barriers. One task group member told the subpanel that so far the task group had listed about 15 pages of barriers and were starting to work on methods to overcome them. The encouraging aspect of this initiative is that it has the backing of top management because in the past, similar reports from individuals and committees have resulted in little or no follow-up by management.

Frustration prevails not only because of the inability to overcome seemingly insurmountable work control problems but also because of constant oversight, schedule pressures, and constantly changing work scopes and priorities. Frustration has turned to low morale and resignation in some instances, but in general the ITR Team found a nearly universal desire predominates to do good work and to improve the conditions in the tank farm. The impact of the new management team appears to be positive and management is slowly bringing about changes.

Recent improvements in the operations area include the following: (1) a clerk has been added to each shift to relieve the shift manager and supervisors of routine duties (typing reports, filing, and others) to better utilize their time for field observations and direct supervisory duties; (2) a shift Engineer has been added to three of the four shifts to provide technical support to the shift manager; (3) an experienced shift coach has been added to each shift. The added staff has assisted operators with the transition to the conduct of operations mode, including the revision of round sheets, turnover procedures, and others.

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APPENDIX A

HANFORD TANK FARM OPERATIONS DEFINITION

A.1 Hanford Historical Mission

Hanford was selected as the plutonium production site during the Manhattan Project of World War II. The 560 square miles of arid land used by the site were remote. The Columbia River provided adequate cooling for the production reactors, and the Boulder Dam ensured adequate electrical power.

Nine production reactors are located next to the Columbia River, and two chemical processing plants are located on a central plateau five miles from the river (Figure 1). The two chemical processing sites, called 200 East and 200 West, are located three miles apart, each covering approximately five square miles. Both the 200 East and 200 West areas contain several very large buildings (called canyons) where chemical processing is carried out, tank farms containing large underground storage tanks for the mixed wastes (hazardous chemicals plus radioactive elements), underground piping interconnecting the tank farms and the canyons, evaporators for concentrating the wastes, burial grounds for radioactive solid wastes and liquid wastes, and support facilities, including office buildings, shops, and steam plants (Figure 2).

A.2 Hanford Tank Farms

The T-Plant, U-Plant, Z-Plant, and REDOX Plant, and the associated tank farms (T, TY, TX, U, S, SY, SX) are located in the 200 West Area. B-Plant and PUREX Plant along with their associated tank farms (A, AN, AP, AW, AX, AY, AZ, B, BX, BY, C) are located in the 200 East Area. The chemical process plants were constructed between 1943 and 1955. The tank farms were constructed between 1943 and 1984. The basic tank design of the first tank farms (T, TY, TX, U, S, SX, A, AX, B, BX, BY, C) was a reinforced concrete, domed shell with an open top carbon steel liner, called a single-shell tank (SST) (Figure 3). Most SSTs are 75 ft in diameter and have a capacity ranging from 530 000 to one-million gallons, depending on the depth of the tank (with the exception of 16 smaller 55 000 gal tanks in the first tank farms, B, C, T, and U).

The tanks in tank farms AN, AP, AW, AY, AZ, and SY are double-shell tanks (DSTs). The DSTs are constructed with both primary and secondary steel liners within the concrete shell (Figure 4). The annulus between the liners permits leak detection and leak confinement should the primary liner ever develop a leak. The DST design was adopted in 1968 and all tanks built later than 1968 have this design.

There are 177 underground storage tanks; 149 are SSTs and 28 are DSTs.

The tanks farms are interconnected to diversion boxes and valve pits with buried transfer lines. Jumpers are used in the diversion boxes to connect the transfer lines that are necessary to accomplish the desired waste-transfer operation. Six cross-site transfer lines connect the 200 West and 200 East area tank farms.

The tanks contain ancillary equipment and instrumentation for waste monitoring, pumping, agitation, condensate recovery, and ventilation control.

A.3 Hanford Wastes

The chemical composition of the waste is very complex, varies significantly from tank-to-tank, and has been changing during the storage period. The radioactive constituents (210 MCi) of the waste account for only a very small percentage of the waste volume. Over the years, four basic chemical-process operations, each with its own chemistry, have been used to recover the plutonium and uranium from the irradiated fuel elements. The resulting aqueous wastes were then made alkaline for tank storage and contain large amounts of sodium nitrate, sodium nitrite, sodium hydroxide, sodium aluminate, sodium phosphate, and organics. The chemistry of the waste was further complicated by three different radionuclide recovery programs, waste concentration, radiolysis, and the addition of miscellaneous waste sources (laboratories, reactor decontamination solutions, for example).

The amount of aqueous waste generated by the chemical processing far exceeded the tank space available. Therefore, several programs were conducted over the years to concentrate the waste and then to decant and partially decontaminate tank supernatant and discharge it to a ground crib. The underground storage tanks currently contain approximately sixty-million gallons of waste in the form of liquid, sludge, and saltcake.

A.4 Tank Farms Current Activities

Currently, the activities of tank farm operations are focused on: resolving safety issues; accomplishing the milestones of the Tri-Party Agreement; maintaining and upgrading the tank farm equipment; bringing an evaporator on-line to concentrate wastes; sampling and characterizing the wastes; and supporting planning for the future retrieval and treatment of tank wastes for final disposal.

Since 1989, 24 safety issues have been identified by reviewing waste tank facilities, operations, anomalies, and investigations. The highest priority issues are (1) the release of flammable gases by some tanks, (2) a potential explosive mixture of ferrocyanide in some tanks, (3) a potential mixture of organic-nitrates in some tanks, (4) a potential for localized concentrations of plutonium exceeding criticality in some tanks, and the (5) continued cooling necessary to remove the heat generated in Tank 106 of Tank Farm C. The United States Congress expressed concern about tank safety at the Hanford Site in Section 3137 of Public Law 101-510 and as a result, 53 tanks (Watch-List Tanks) have been identified as having a serious potential for release of high-level waste caused by uncontrolled increases in temperature or pressure. Other safety issues include toxic vapor release, inoperative safety equipment, and deficiencies in operations, documentation, and waste characterization.

The physical condition of the tank farms has been neglected for many years and the condition of the equipment precludes many routine operations. The tank farms are currently making an effort to maintain the present equipment and instrumentation while planning and executing upgrade programs that will install new equipment and instrumentation. The major upgrade programs include new cross-site transfer lines and new DSTs.

The design basis of the tank farm physical structures is undergoing reconstitution and improvement. Programs are underway to produce as-built drawings, design-basis calculations for structural and seismic loading conditions, operational specifications, operational-safety requirements, risk analyses, and safety-analysis reports.

SST leakage events began in 1956 and increased in the 1960s and 1970s. Currently, 66 of the older SSTs are either known to leak or are suspected to have leaked. A program was started in the 1970s to remove as much of the free liquid as possible from the SSTs and to isolate the tanks by sealing the drain lines that emptied into the tanks. That program has been suspended until the tank safety issues are better understood.

The complicated nature of the radioactive liquids, sludges, and salts contained in the tanks makes it necessary to sample and characterize these wastes to support the planning for retrieval, treatment, and disposal. Regulatory permits also require characterization of the wastes. The tank farm operations has recently increased the capacity to take the tank samples and carry out the analysis.

Low-activity wastes are continually generated in the chemical process buildings, even under shutdown conditions, and then sent to the tank farms. The available tank space is very limited and the 242A Evaporator facility has been upgraded with the expectation of starting a waste-concentration program in the summer of 1992. The Liquid Effluent Retention Facility, providing necessary storage for the evaporator condensate, is also scheduled for start up during this period.

Another program to make more tank space available is the incorporation into grout of the liquid wastes from 8 DSTs. The liquid waste has been designated as low-level waste and the current plan is to place the resulting low-level grout into RCRA-qualified vaults on site.

In addition to tank farm operations, the Tank Waste Remediation System within Westinghouse Hanford Company includes the retrieval, pretreatment, vitrification, and grout operations that are necessary to accomplish the final disposition of the tank wastes.

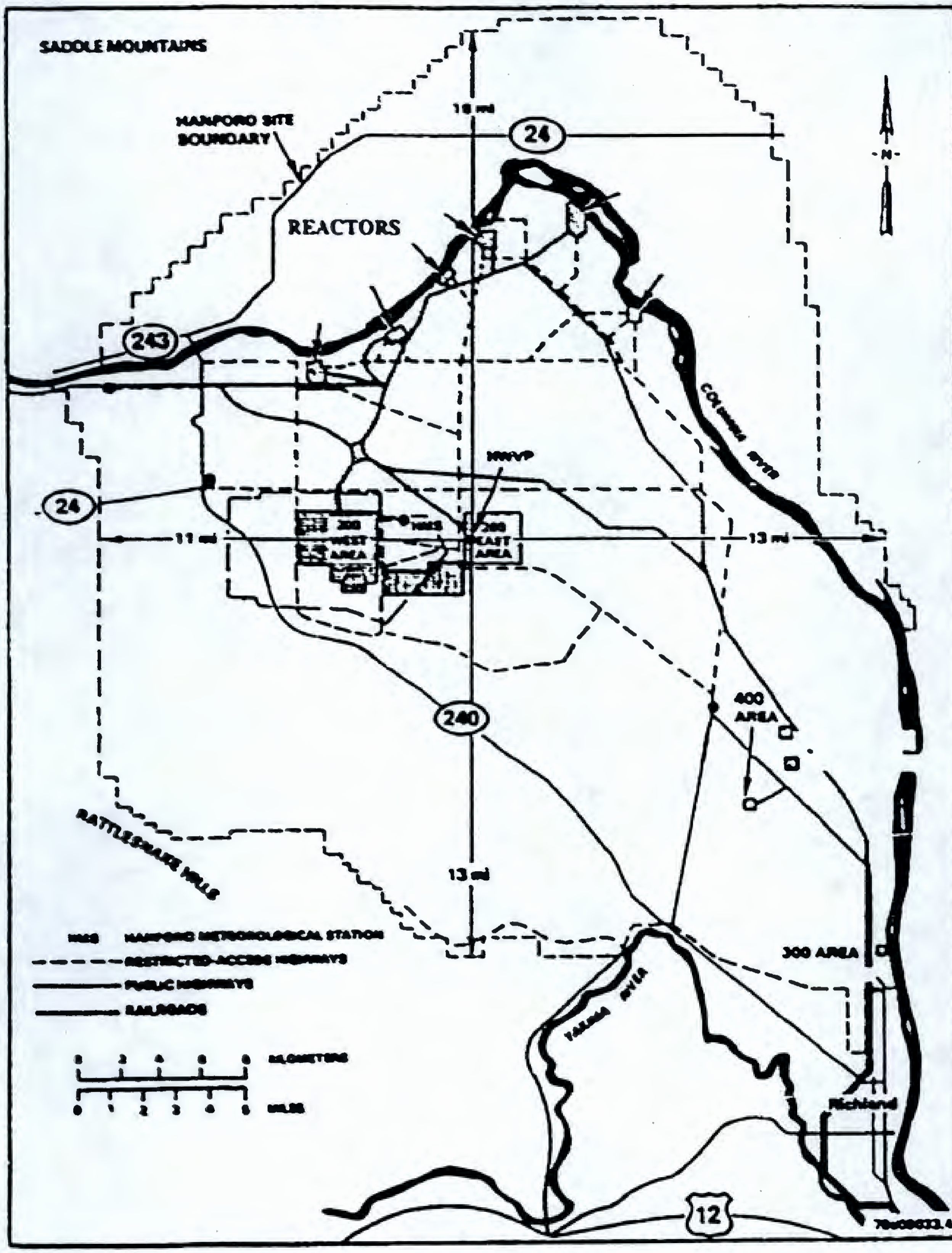

Figure A-1. Hanford Site

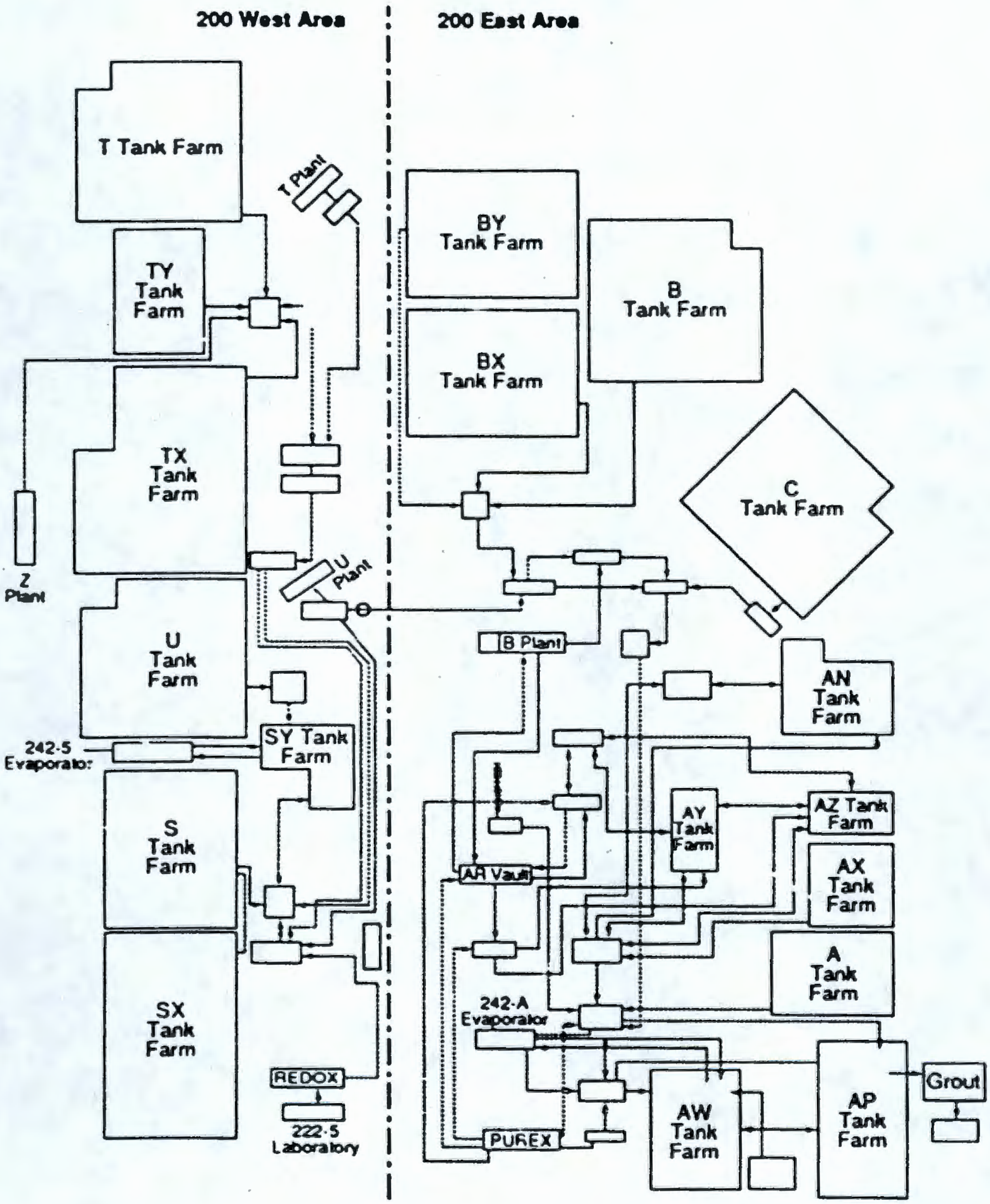

Figure A-2. Schematic of 200 West and 200 East Chemical Process Areas

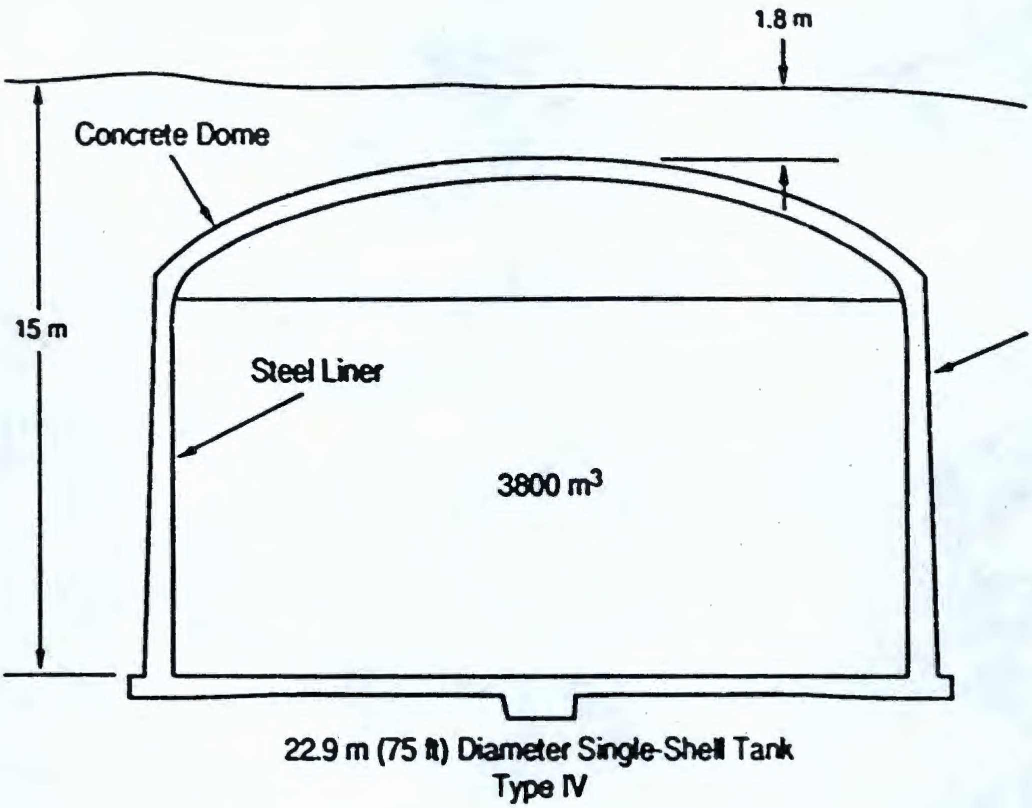

Figure A-3. Single Shell Tank

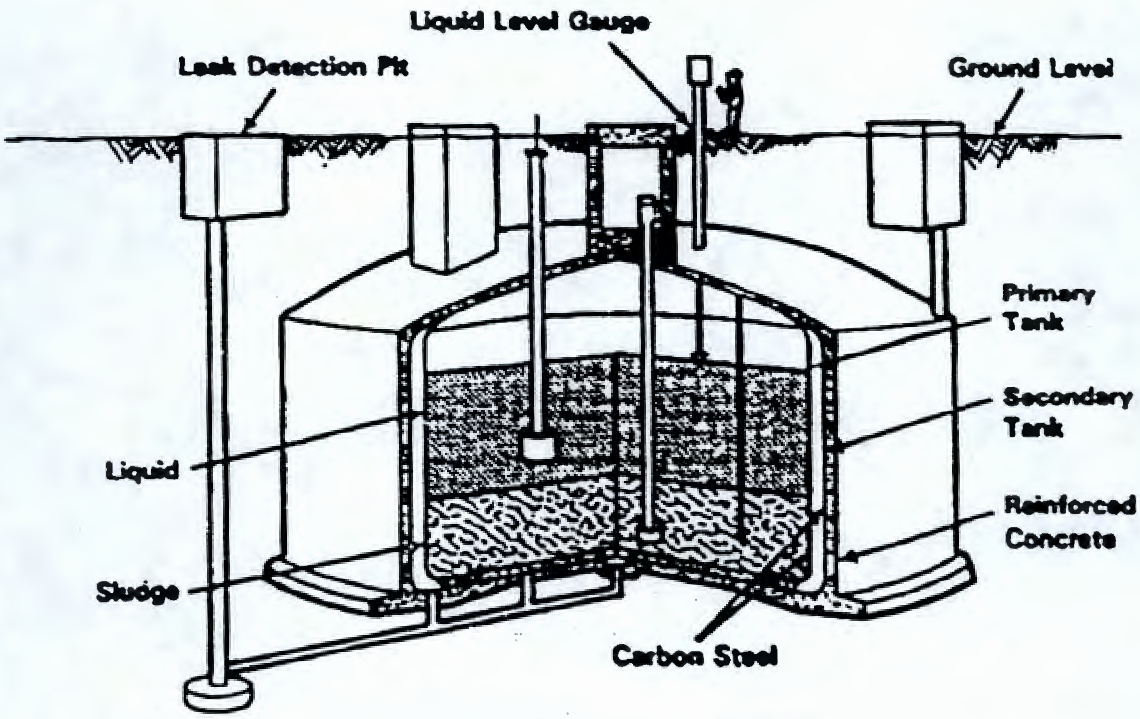

Figure A-4. Double Shell Tank

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Appendix B

Hanford Tank Farm Operations Management

The activities of the Hanford Tank Farm Operations are managed through the Department of Energy Richland Field Office (DOE-RL) and the Westinghouse Hanford Company (WHC). As a result of the Independent Engineering Review of the Hanford Waste Vitrification System (HWVS), WHC integrated their tank waste remediation activities within a single organization, the Tank Waste Remediation System (TWRS).

Figure B-1 shows the DOE-RL organizational structure elements as well as the responsibilities for activities management within the TWRS organization of WHC. The organizational structure of WHC, specifically the overall WHC organization, the TWRS organization, and the Waste Tank Project organization, is summarized in Figures B-2, B-3, and B-4. As indicated in Figure B-1, the management responsibility for TWRS activities within DOE-RL is divided between the Tank Waste Disposal Office and the Tank Farm Project Office. Thus, the WHC TWRS Vice-President reports to two DOE-RL Managers.

Funding is allocated according to a work-breakdown structure in which the Level 3 program elements correspond to Activity Data Sheets(ADS). The Waste Tank Safety and Operations program contains four program elements or "end functions." The four end functions and their associated funding, including capital, are as follows: Operations and Maintenance - $92.2m; Safety Programs - $32.9m; Tank Upgrades - $21.9m; and Waste Characterization - $19.8m. The total funding for the Waste Tank Safety and Operations program is $166.8m for FY 92. TWRS has allocated $127.3m to Double Shell Tank (DST) Waste Disposal for FY 92. In FY 91, 80% of the work was considered to be "level of effort." In FY 92, DOE-RL tied work activities to specific milestones. In FY 93, funding will be by ADS, with change authority at DOE Headquarters (DOE-HQ).

The overall staffing level of the tank farms, including the 222-S Laboratory, is about 1000 (including 522 degreed and 412 bargaining unit personnel). Additional manpower support is provided via matrixed personnel from other WHC divisions as well as from Kaiser Engineering Hanford (KEH). For example, health physics and industrial hygiene support is provided from the Environmental Safety and Health Quality Assurance (ESH&QA) organization.

The Hanford site is in transition from contractor-directed activities with DOE oversight to DOE-managed activities implemented by the contractor. The activities are controlled by means of cost accounts tied to a site-work breakdown structure.

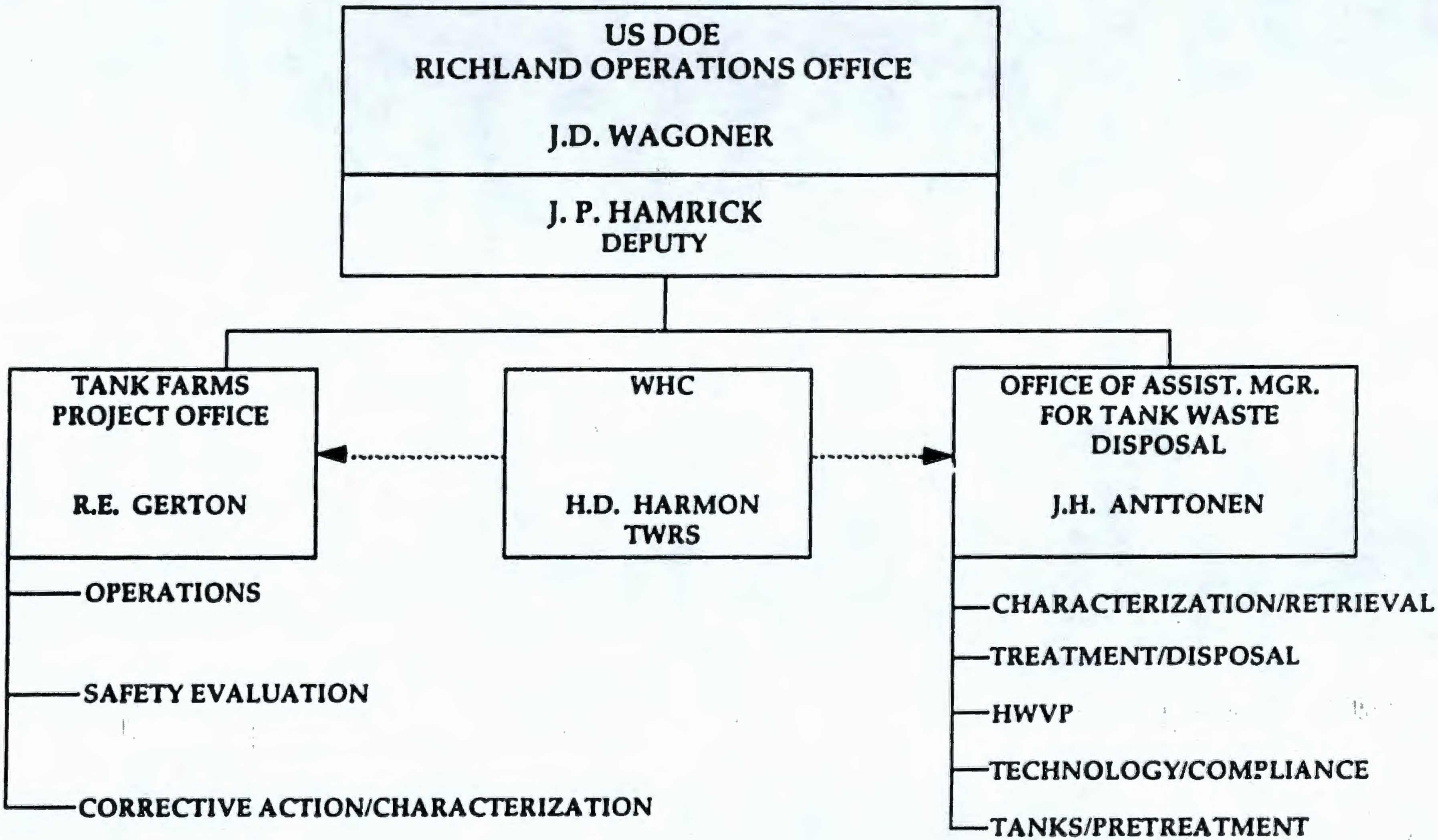

Figure B-1. Department of Energy Organizations Directing Westinghouse Hanford Company Tank Waste Remediation System Division

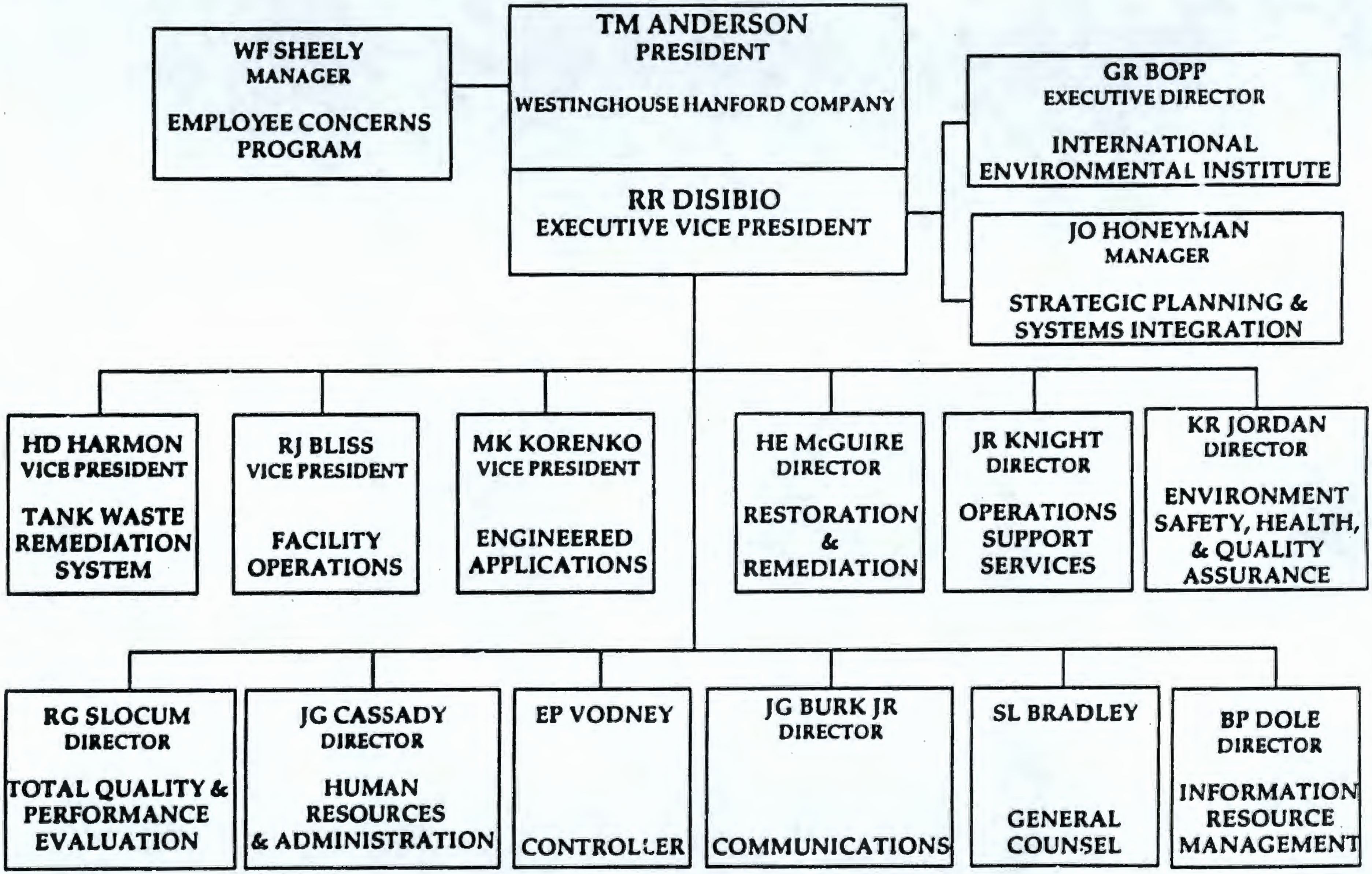

Figure B-2. Westinghouse Hanford Company Major Divisions

Tank Waste Remediation System Division

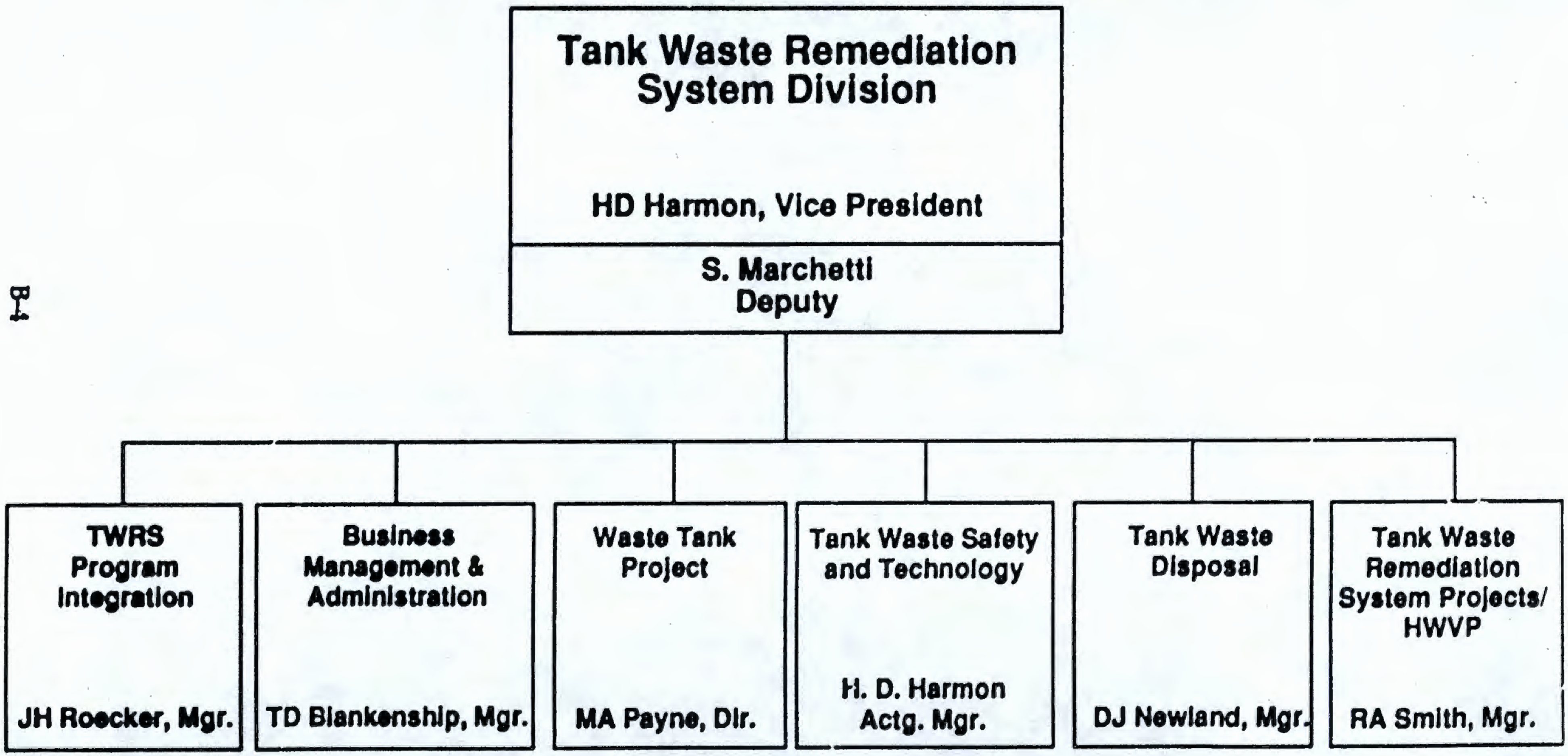

Figure B-3. Organization of the Westinghouse Hanford Company Tank Waste Remediation System Division

Waste Tank Project

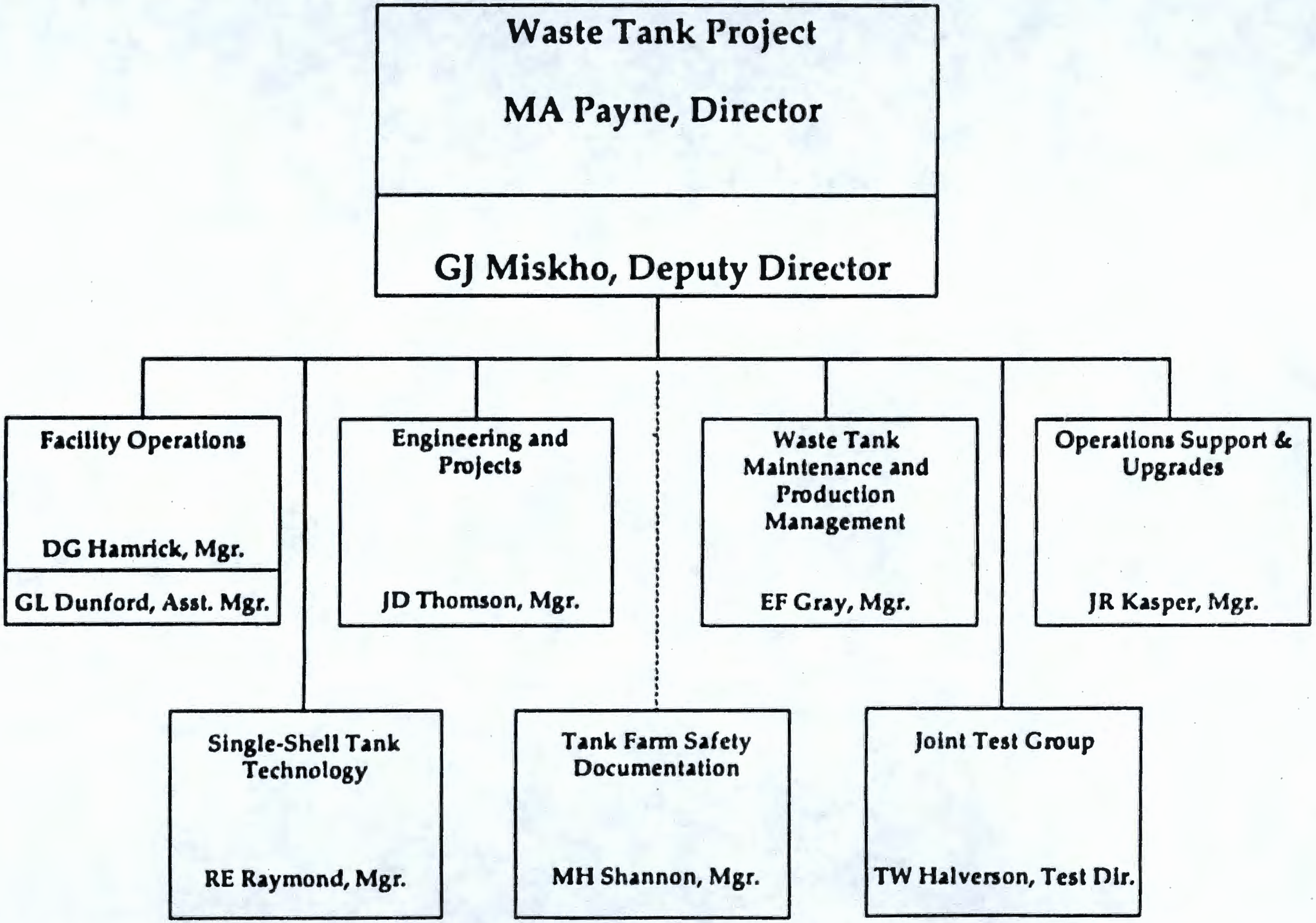

Figure B-4. Organization of The Waste Tank Project within the WHC TWRS Organization

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APPENDIX C

PHENOMENONOLOGY SUBPANEL ASSESSMENT

C.1. Review Process

The Phenomenology Subpanel examined the principal physical and chemical phenomena associated with the HTFO. The review included but was not limited to:

- *Potential safety problems*
- *Science of the waste and processes*
- *Analytical and ancillary tank facilities*
- *Interaction with other waste generating processes*
- *State of technology*

C.2. Summary of Findings

The findings of the subpanel covered the general areas of tank-safety issues, tank-related issues and facilities, and ancillary facilities and processes.

C.2.A. Tank-Safety Issues

Tank-safety issues included flammable gas, organic-nitrates, ferrocyanide, criticality, and vapors.

Data from many studies on gas generation in Tank 241-SY-101 (101-SY) (WHC-EP-0517) indicate that hydrogen is a by-product of organic radiolysis and that radiolysis of nitrate and nitrite forms nitrous oxide. New instrumentation has been installed on 101-SY to measure gas evolution more accurately. WHC is evaluating several methods to promote continuous gas release instead of periodic releases (burps). WHC also plans to install and test in-tank mixing equipment on 101-SY and is evaluating other tank mixing concepts.

The subpanel concluded from TRAC-derived (Tracks RAdioactive Components) (Brett C. Simpson, 1992) data that three tanks may contain a high amount of fissile material requiring further evaluation. Because TRAC, the main source of historical records, has limited reliability, more core characterization or *in-situ* measurement of fissile materials is necessary to further define the extent of potential criticality issues.

Ferrocyanide is used at Hanford to selectively precipitate and concentrate ^{137}Cs from waste. The subpanel feels that determination of the decomposition of ferrocyanide is very important because a potentially explosive ^{137}Cs-rich ferrocyanide layer can form in the waste tanks. Absence of such a ^{137}Cs-rich layer when a gamma probe was inserted into some waste tanks suggested that metathesis/hydrolysis of ferrocyanide may have occurred, leaving the cyanide and ^{137}Cs in the liquid phase. Radioactive samples must be tested in the adiabatic calorimeter to validate the data from the less sensitive differential scanning calorimeter and to fully assess the potential for explosive energy release in the waste tanks.

C.2.B. Tank-Related Facilities/Issues

Tank-related issues included corrosion, tank stabilization, new tanks and transfer lines, relevant seismic criteria, and TRAC.

Sometimes failure to observe the site-developed Operational Safety Requirements (OSR) and Operational Specifications causes damage to tanks, resulting in increased risk for personnel and environment. For example, the Operational Specifications limits have been violated since 1985 in Tank AN-107, which could result in tank damage.

The tank stabilization program will reduce the liquid level in the tanks. Photos have shown a salt rim on the tank wall above the liquid level. As the tanks breathe or are actively ventilated, carbon dioxide from the air will react with the caustic in the salt rim and change the pH, creating the potential for crevice corrosion or concentration-cell corrosion on the tank wall.

WHC proposes to build four proposed new tanks that will probably be constructed of austenitic 304L stainless steel. If the tanks are used for the pretreatment of wastes, acidic or neutral process solutions containing halides could cause pitting or stress-corrosion cracking. Although stainless steel is more resistant to corrosion by nitrate and hydroxide, studies to evaluate potential corrosion conditions must be performed before selecting the materials of construction.

C.2.C. Ancillary Issues/Facilities

The ancillary issues and facilities review included the analytical laboratories and related equipment, a laboratory information system (LIMS), sampling, storage and archiving, spatial variations in tanks, and outside laboratory work.

The analytical laboratory's transition from a support group for routine plant operations to a major participant in the TWRS program appears to have been hampered not only by failure to take a proactive role in the past but also by inadequate resources. For example, while the planning, development, and budgeting for a hard-salt sampling truck to increase the core sampling rate was in progress, a parallel plan was not made to upgrade the laboratory's capacity to support this sampling. An integrated plan should have included upgrading analytical personnel, equipment, and facilities. In addition, lack of an LIMS is significantly affecting productivity. The filter 222-SB plenum upgrade is a major problem that could affect the ability of the 222-S laboratory to utilize the new hot cells. At present, the bottleneck is sample storage and archiving, but hot-cell capacity is expected to become a limiting factor in 1993.

A new coordinating group appears to help balance the needs of the various programs with the ability of the analytical group to complete sample analysis. Although, analytical efforts that address the top safety problems appear to be sufficient, other important issues needing analytical support may be delayed.

Current analytical schedules are based on the idealized projection that all funding will be received and that no delay will occur in any given task. The schedules seemed to be optimistic because resources needed for some upgrades or projects were either underestimated or unavailable (such as the LIMS and 222-SB filter plenum). All planned projects must stay on schedule to attain the schedule projections and to meet the milestones.

C.2.D. Ancillary Processes

Significant uncertainty is associated with the level of development required before advanced technologies of chemical separation and organic destruction can be implemented. About seven years may be required for additional development after deciding to install these processes as part of a new pretreatment facility.

As stated in earlier Independent Technical Review (ITR) Team reports, the Hanford strategy for removal of radionuclides from low-level wastes fed to the grout facility is inconsistent with practices at the Savannah River Site (SRS) and at West Valley. The Hanford process removes much less ^{137}Cs than the processes used at SRS and at West Valley, resulting in a very high ^{137}Cs concentration in grout produced at Hanford. Because of the high concentration of ^{137}Cs in the grout, the states of Washington and Oregon have submitted a petition to the U.S. Nuclear Regulatory Commission (NRC) requesting a ruling to require removal of the largest technically achievable amount of radioactivity before grouting. The capability to remove ^{137}Cs (but not other radionuclides of interest) from the feed to grout will not be available until about 2007, assuming that ^{137}Cs ion-exchange capacity would be located in the pretreatment facility.

C.3. Tank-safety Issues

C.3.A. Flammable Gas

The subpanel inquiry focused on Tank 101-SY, a double-shell, high-level waste tank that contains about one-million gallons of concentrated waste from the 242-S evaporator (WHC-EP-0347, WHC-MR-0132, RHO-SA-51, ARH-CD-610B). In 1990, an unresolved safety question (USQ) was declared on 101-SY because of periodic (about 100-day intervals) release of 8 000 to 12 000 ft^3 of gas into the head space (35 000 ft^3). The gas contained hydrogen/nitrous oxide/nitrogen concentrations that in less than one hour can exceed the lower flammability limit (LFL) or the lower explosion limit (LEL). The following safety precautions are taken. Air (600 ft^3/min) is mixed with head-space gas to dilute the mixture to a concentration below the LEL/LFL of 4% hydrogen in air and 3% hydrogen/nitrous oxide in air. Potential ignition sources have been removed from the tank and all in-tank experiments are conducted after a gas release. Tank 101-SY has the largest gas release, although 22 other tanks release smaller concentrations of H_2 and other flammable gases.

Data from detailed chemical analyses of cores removed from 101-SY after a gas release event show that the contents of the tank consist of a crust, an upper convective layer, and a lower, nonconvective layer. The lower zone may not liberate all of its gas in each event. Results of analyses of the organic materials indicate that very complex radiolysis reactions have converted nearly all of the original organic compounds (EDTA, diphosphonic acid, and others) to complex reaction products. It is now believed that hydrogen gas results from organic decomposition caused by radiolysis and thermal chemistry, and that radiolysis of nitrites and nitrates in the waste forms nitrous oxide. Efforts to duplicate the hydrogen/nitrous oxide ratio found in Tank 101-SY have been encouraging and are continuing..

WHC is investigating the following gas-mitigation methods: (1) in-tank mixing, (2) heating, (3) dilution, and (4) ultrasonic. In the fall of 1992, WHC plans to install an in-tank mixer in Tank 101-SY and then assess its mixing efficiency. Jet mixing is believed to fluidize the salt solutions and crystals so that the gases will be released as they are formed. If the gases are released, the concentrations in the tank dome will remain well below the LFL and minimize the possibility of an explosive vapor-phase burn or a crust burn in Tank 101-SY. Other in-tank systems to evaluate heating, dilution and ultrasonics on gas release will be installed and tested later. WHC did not present chemical concepts for controlling gas formation. The ITR team received presentations describing the proposed mitigation measures but did not pass judgment on their efficacy.

The program to understand and develop mitigation measures for the flammable-gas-emitting waste tanks appears to be well founded and conducted on an aggressive schedule.

C.3.B. Organics

Many organic compounds, such as chelating agents (EDTA, diphosphonic acid, and others), solvents (NPH), and extractants (TBP), have been used at Hanford in waste reprocessing (WHC-EP-0347, WHC-MR-0132, RHO-SA-51, ARH-CD-610B). These organic compounds were added to the waste which contains high concentrations of the oxidizers sodium nitrate and sodium nitrite as a result of the reaction between the neutralizer (sodium hydroxide) and the chemical process solutions of nitric acid and nitrates. The mixture of an organic fuel and an oxidizer creates the potential for an exothermic chemical reaction. Less than half of the organic compounds in the waste tanks can be identified and quantified because radiolysis has converted most of the original compounds to a very complex reaction mixture. Apparently, historical records and TRAC data are inaccurate and cannot be used to identify tanks with potential safety problems. Therefore, core-characterization data are essential to help define the concentrations of the organics, oxidizers, and diluents, such as water and inert salts, in the waste tanks.

The adiabatic calorimeter is now being integrated along with the differential scanning calorimeter into ferrocyanide and organic safety studies (WHC-SD-WM-TP-104). The adiabatic calorimeter is a much more sensitive and accurate measurement of energy evolution because it uses a much larger sample (from 10 to 20 g) than that used by the differential scanning calorimeter (10 mg). The differential scanning calorimeter has been the main instrumental technique used to measure reactions between fuels and oxidizers. The differential scanning calorimeter slowly heats a 10-mg sample and measures energy absorption and release. Present plans involve differential scanning calorimeter measurements on radioactive samples to determine their thermal response. A limited program exists to use the adiabatic calorimeter to test simulated samples. The adiabatic calorimeter should be used to test radioactive samples to validate data and conclusions from the differential scanning calorimeter. When a database on both methods is developed, greater reliance can be placed on the differential scanning calorimeter, which is considerably faster. Similar comments apply to the testing of waste tanks that contain ferrocyanide.

The program to understand and develop mitigation measures for the waste tanks containing organic nitrates is in an early stage of development. Only minimal activities were planned for FY 92.

C.3.C. Ferrocyanide

In a series of waste-reprocessing campaigns at Hanford, ferrocyanide was used to selectively precipitate and concentrate ^{137}Cs (WHC-EP-0347, WHC-MR-0132, RHO-SA-51, ARH-CD-610B, WHC-SA-1369). Studies performed at Pacific National Laboratory (PNL) and Los Alamos National Laboratory (LANL) have shown that dry mixtures of ferrocyanide, nitrates, and nitrites can react exothermically and explosively. Time-to-explosion (TTX) tests were conducted to verify the thermodynamic calculations (PNL 7928). Information on ferrocyanide from TRAC data is not accurate for safety considerations.

The amount of energy that can be released from a waste tank under nonideal conditions is the major tank-safety issue. Thermodynamic calculations have been used to predict energy release; the differential scanning calorimeter and representative process flow sheets have been used to assess the role of water and salts on reaction rates and energy release. Characterization of the waste in the tank is essential to determine the concentrations of ferrocyanide, nitrate/

nitrite, organics, and diluents. Diluents (water, sodium nitrate and nitrite, aluminates, sodium hydroxide, and sodium carbonate) will influence heat capacity, thermal conductivity, and potential exothermic reactions in the tank waste. The role of diluents is very important because radiolysis has a large effect on tank-waste chemistry.

Milligram samples of diluents can be measured in the differential scanning calorimeter at controlled heating rates. Fauske and Associates and WHC in the 222S Laboratory have tested larger samples in an adiabatic calorimeter. In the adiabatic calorimeter, a 10 to 20 g sample is heated to a predetermined temperature, monitored for exothermic reactions, and then heated to a higher temperature. This technique is more sensitive than the differential scanning calorimeter and can be used to determine (1) exothermic reactions in the waste, (2) the amount of energy released, (3) the temperature dependence of the reactions, and (4) the temperature at which reactions become significant. The subpanel feels that adiabatic calorimeter testing on actual tank waste is essential to assist in resolving complex tank-safety questions. Although many safety tests can be conducted, the adiabatic calorimeter will provide essential information on radioactive samples from the waste tanks. Since water is the major diluent, knowledge and control of the concentration of water in surface crusts and in the bulk solution are essential before the stabilization program resumes in ferrocyanide tanks.

The subpanel recommends that ferrocyanide safety studies consider the possibility that the suspected ferrocyanide compounds have been decomposed by metathesis/hydrolysis/radiolysis. Metathesis and mixing of the ^{137}Cs-cyanide complex would leave the ^{137}Cs in solution and distributed throughout the tank rather than in the sludge strata, resulting in a maximum dilution effect with much less potential for exothermic reactions in the waste tank. High concentrations of ^{137}Cs detected by a gamma probe inserted into the waste tank should indicate high ferrocyanide concentrations because the ^{137}Cs is precipitated with ferrocyanide. Analysis of some tanks with a gamma probe revealed ^{137}Cs concentration variations that did not indicate formation of a ferrocyanide layer. Although the average hydroxide concentration in a waste tank is lower than that considered necessary for metathesis, the presence of a concentrated hydroxide-enriched liquid phase (due to selective crystallization following concentration of the waste) and the presence of radiation could cause metathesis.

The program for ferrocyanide safety studies is on a longer schedule than that of the flammable gas studies. The program has not yet established whether the situation actually exists.

C.3.D. Criticality Safety

In June, 1991, an spreadsheet calculation of a sample analysis resulted in an apparent infraction of a Criticality Prevention Specification (CPS) limit for

Tank 104-C. The spreadsheet calculation of this single core sample indicated a plutonium inventory of 185 kg in a tank having a limit of 125 kg of equivalent plutonium. The analysis was then recalculated by hand using another method that showed a content of 56 kg. An error was then found in the spreadsheet calculation. After the incident, WHC issued An Unusual Occurrence Report (UOR) and formed an investigating committee to review the criticality safety in all tanks with an appreciable quantity of fissionable material. The review was expanded in November 1991 by a Nuclear Criticality Safety Review Team (NCSR, 1991). The team concluded that a tank-farm nuclear criticality accident was not an imminent risk because the maximum plutonium concentration in core samples from single-shell tanks (SST) is about one-tenth that of the established criticality limits. About two-thirds of the SSTs have been stabilized by pumping accrued liquids and no waste has been added to any of the SSTs since 1980 (WHC, UOR RL-WHC-TANK FARM 1991-1021; WHC Internal Memo 76400-91-023). Tanks 104-C, 106-C, and 102-SY are believed to have high inventories of fissionable material and must be evaluated.

The Nuclear Criticality Safety Review Team found that

- *Definitive knowledge is lacking about fissile inventory and distribution in the tanks. Historical data is limited and hard to interpret and often disagrees with analytical data. Of particular concern are the DSTs where fissile inventory and distribution are not well known and where continued addition of fissile material to these tanks poses a potentially significant risk. Localized concentrations of fissile materials in the tanks caused by operation of the air lift circulators may provide a mechanism for this to happen.*

As a result of studies by WHC and the Review Teams, (1) the Operational Safety Document (OSD) limits (to be issued in May, 1992) for the DSTs have been revised to 125 kg total plutonium equivalent and 2 g plutonium equivalent/L maximum, (2) a document is being issued to make criticality implication a criteria in determining which tanks to core sample, and (3) a Tank Farm Criticality Safety Representative has been assigned full time.

C.3.E. <u>Corrosion</u>

OSD standards define concentration limits for the SSTs and for the DSTs. The limits are given in the Operating Specifications for the 241-AN, AP, AW, AY, AZ, and SY Tank Farms, Document No. OSD-T-151-00007, Rev/Mod H-5. These standards are often not followed. Tank 241-AN-107 has been out of OSD specifications since 1985 because of a low hydroxide concentration that is adequate to initiate a corrosion sequence that could damage a tank.

If a corrosion test solution accurately simulates the actual solution, it is likely that the test results will be valid. The validity of some of the compositional limits in the OSDs is questionable because the test data were developed with synthetic solutions that did not include chloride. The absence of chloride in the testing is a serious omission that must be evaluated because chloride is such an aggressive anion. Tank SY-101 contains 0.34M chloride (12 000 mg/L or ppm), a very high concentration that could lead to pitting corrosion but is not expected to cause cracking in the type of carbon steel used in construction of the tanks. Moreover, the testing was done on the basis of a statistical matrix for the base metal, not on welded test specimens. Corrosion studies have shown that the heat-affected zone of the weld is the most likely place for attack. The high-heat-load SSTs, such as 106-C, are the tanks most likely to have a problem with stress-corrosion cracking.

Some of the tests that were performed to develop OSD corrosion standards for the tank farm should be done again to determine if there is an effect from the high chloride in the waste. This is especially true for pitting corrosion. Analysis of waste showed a concentration of 0.005 to 0.11 M chloride in tanks at SRS. Such chloride concentrations were maintained by mixing waste and by avoiding chloride-containing waste. Chlorides were included in the test matrix for the ranges observed at SRS, and the steel was shown to be protected against corrosion under the proposed SRS standards

WHC OSR/OSD limits do not require a routine sampling program to ensure that the tanks are within compositional requirements. Data presented to the subpanel showed that samples and analyses taken in the tank farms are inadequate to maintain the OSD limits. A periodic sampling schedule should be developed and implemented. For example, the data in Table I show that some tanks containing high concentrations of chlorides have not been analyzed in over five years.

Table I

Available Values of High Chloride In Double-Shell Tanks

Tank	Year Sampled	Temperature (°C)	Chloride ion (Molar)
103-AN	1986	46	0.24
104-AN	1985	49	0.17
104-AW	1984	Low	10.6
101-SY	1992	56	0.34
103-SY	1985	45	0.26

The subpanel was concerned about the inadvertent addition of significant quantities of domestic water to two DSTs in 1991. In one incident, approximately 2700 gallons was added to tank 241-AW-102 during checks of the safety showers and an eye-wash station (UOR No. RL-WHC-TANKFARM-1991-1050). In a second incident, approximately 500 gallons of raw water was added to Tank 241-AW-102 when a safety valve was activated (UOR No. RL-WHC-TANKFARM-1991-0175).

In summary, it appears that regarding corrosion control, the stewardship of the tanks has not been acceptable. The OSR/OSDs were developed from tests that were performed only on the base metal, excluding welds and heat-affected zones from the test matrix. Chlorides were not added to the test solutions because exogenous chlorides were not added purposely to the wastes; however, chlorides are inherently present in DST wastes, and further corrosion testing should be conducted to determine their effect. Tanks 241-AN-102 and 241-AN-107 are consuming hydroxide for an unknown reason. Tank 241-AN-107 has been out of OSD standards since 1985. The subpanel considers that allowing a tank to be out of Hanford's own specifications for over seven years is unacceptable.

C.3.E.1. Corrosion Surveillance. Members of this subpanel have concluded that measurements should be made on corrosion samples in synthetic waste, and that some corrosion samples should be installed in a few typical waste tanks for *in-situ* testing. Although the subpanel does not believe that general corrosion is a tank-safety problem, pitting corrosion and stress-corrosion cracking may affect tank safety (WHC-EP-0182-45).

Measurements of the electrochemical potential of the primary steel waste tank versus that of a standard electrode can determine if the steel is in the hydroxide or nitrate cracking range. For tanks in the cracking range, placing a series of compact tension samples into the waste tank to test whether the crack grows is the best approach. Another approach is testing welded samples by the slow strain rate or by the Constant Extension Rate Tensile Test (CERT) method under potential control in synthetic solutions (ASTM STP 665, 1979).

To test for pitting, welded coupons can be put in the tank waste and then be removed periodically for examination. Pitting is a statistical problem, therefore, minimum surface areas for the sample should be estimated. In addition, electrochemical measurements (the hysteresis loop formed by a polarization scan that is then reverse scanned) can be used with synthetic waste to determine attack (ASTM Method Q-61, 1986). In the event of a small loop, the sample should be examined from base metal, a heat-affected zone, and from weld metal.

C.3.E.2. Stabilization and Isolation. Tank stabilization to reduce the potential for leakage of radioactive waste from the waste tanks into the environment is one of the major items in the Tri-Party Agreement (TPA). Tank stabilization consists of removing any pumpable liquid from the waste tank by a Salt Well Pumping process. However, several potential problem areas exist in the stabilization program. Because of solubility effects, the pumping increases the concentration of highly soluble salts (sodium hydroxide, sodium aluminate, ^{137}Cs, and potentially ^{99}Tc) in the liquid pumped from the waste tanks, thus reducing the average concentrations of sodium hydroxide and corrosion inhibitors in the remaining salt. As the tanks breathe or are actively ventilated, carbon dioxide from the air will neutralize some of the sodium hydroxide remaining in the tank and lower the pH. Tank waste solutions will not meet the OSD requirements if the pH is below 11 because such a weakly basic solution could corrode the tank wall under the salt rim or at the liquid-vapor space interface. Compared with the original aqueous phase, the salts remaining in the tank in contact with the steel will be enriched in sodium nitrate. If the tank is warm (>50 °C) and water vapor is produced that wets these salts, the concentration of aggressive ions will be high at the tank wall. Neither the nitrate concentration that could cause cracking nor the hydroxide and nitrite concentration that act as inhibitors, would be known in localized areas. The possible negative affects of removing the waste tank concentrated liquor must be balanced against the potential of having more liquid in the tank that could leak to the environment if the tank should have a crack. Crevice corrosion and concentration-cell corrosion are two possible types of corrosion.

Other potential problems are the measurement and control of moisture levels in the crust of the tanks containing ferrocyanide and organics. Water is a major diluent and may be required to maintain these wastes in an inherently safe condition. Another potential consequence of the stabilization program is the formation of a hard crust on the tank that may be difficult to remove. This problem is believed to be a minor concern, however, based on early work at SRS (DP-1135). Before the tank stabilization program resumes, the potential effects of these technical concerns must be addressed.

C.3.E.3. Tank Failure. Before the questions pertaining to tank failure can be addressed, it is necessary to define a "failed tank." The present method used at Hanford to define a *leaker* or *assumed leaker* is the presence of radioactivity outside the tank. Tanks are characterized as assumed leakers if radioactivity is found in the vicinity of one or more tanks and it cannot be established which of these tanks is the source of the waste. To state whether a tank is a leaker or assumed leaker is very difficult because one or more cracks in the steel tank can be effectively plugged by waste that solidifies in the cracks. In addition, if waste were to leak through the crack, it could solidify in the thick concrete portion of the waste tank, thus preventing radioactivity from getting into the environment. Monitoring the liquid level in the waste tank is one method to detect tank failure. A one-inch change in liquid level in the tank is equal to approximately 2700 gallons of waste. However, such monitoring is valid only in the event that (1) the solution in the leaking tank is dilute and does not solidify and plug the crack, (2) the leak is not near other tanks, (3) the tank failure results in very large opening, or (4) the conductive tip of the level measuring tape does not become covered with a conductive "ice side." The official Hanford position is that 66 of the 149 SSTs are assumed leakers. However, based on information that WHC personnel presented to the subpanel and on the experience of some of the subpanel members, it appears to be impossible to quantify whether a specific SST does or does not have cracks/leaks in the steel tank.

C.3.E.3.a. Single-Shell Tanks. Many variables in construction and operation could cause the failure of an SST. The reasons for failure of SSTs are difficult to determine because temperature, waste solution transfers, and compositions were not adequately documented. Corrosion/failure could have been caused by low hydroxyl ion concentration coupled with high chloride concentration or other corrosion accelerators, such as fluoride and high temperatures. Failure to stress relieve the waste tanks by heat treatment after construction may have contributed to corrosion or stress-corrosion cracking.

Information collected for the Watch List Tanks indicates that corrosion in SSTs may be worse for tanks with high heat loads and tanks containing ferrocyanide than for tanks containing organics [>3 weight % total organic carbon (TOC)] and hydrogen generators. This conclusion, based on data from a limited number of tanks, is summarized in Table II (WHC-EP-0182-45).

Table II

Summary of Watch List Tanks

Type of Waste	Total Tanks	Number Failed
High Heat	11	9
Ferrocyanide	24	13
CC (>3 weight % TOC)	8	2
Hydrogen	18	2

C.3.E.3.b. Double-Shell Tanks. DSTs have not leaked. Present OSR/OSD limits should be reviewed, revised, and, if necessary, solution composition limits must be followed.

C.4. Tank Related Facilities/Issues

C.4.A. New Waste Tanks

WHC proposes to build four one-million-gallon waste tanks as a multifunction facility. The tanks are to be used for (1) storage and remediation of waste from tank-safety issues, (2) process and pretreatment of waste before vitrification, (3) storage of waste from retrieval of SST waste and (4) management of waste from 200 Area decontamination. Preliminary findings indicate that (1) the primary vessels (steel in contact with waste) are to be fabricated of austenitic stainless steel (probably 304L), and (2) the secondary vessels will be constructed of stainless steel for two waste tanks and of carbon steel for the other two tanks. Austenitic stainless steel is normally used for storage and treatment with nitric acid solutions. Solutions resulting from decontamination/cleanup of facilities at Hanford will probably contain nitric acid. It is also possible that wastes will be pretreated with nitric acid.

Halides must be excluded from acidic or neutral solutions to prevent the possibility of transgranular stress-corrosion cracking. If low levels of halides are present in the waste solutions, corrosion tests must be run to determine the levels of halides that are allowable under proposed processing or storage conditions. The complex compositions of the waste solutions makes their corrosiveness difficult to predict without testing. However, general corrosion will not be a problem as long as a strong alkaline storage condition is maintained.

Hanford wastes are presently stored as basic waste because the storage tanks are constructed of carbon steel. Pitting corrosion will occur only in *slightly basic solutions* (pH <11), not in *highly basic solutions* (pH >11). Pitting and stress-corrosion cracking should be studied before the tanks are constructed. Pitting corrosion can be studied either electrochemically or with coupons in synthetic waste solutions at (or slightly above) the proposed storage temperature. For stress-corrosion cracking tests, the slow-strain-rate test is recommended because of its severity and because it gives representative test data with smaller samples. At SRS, carbon steel waste-storage tanks cracked even though the original test welded-steel coupons did not crack because the test samples were too small to retain welding stresses. Large test samples (36" x 36" x 3/4 ") that are difficult to handle must be used to obtain good test data. Welded samples should be used for the pitting and stress-corrosion cracking tests because the most probable area of attack in both cases will be the heat-affected zone of the weld.

If the tanks will contain thermally hot (>50°C) solutions, cooling coils should be installed to control the temperature during in-tank processing. Corrosion tests must be run at or above the proposed operational temperature because all corrosion reactions are thermally activated. The excellent service obtained from the Hanford waste evaporator design (operated at reduced pressure and therefore low temperature) attests to the merit of low-temperature operation.

C.4.B. Transfer Lines

Three piping systems will be built or upgraded to transfer radioactive wastes: (1) the West Area Waste Transfer System (W-201) and (2) the East Area Transfer System Upgrade (W-201) (which will supply transfer lines between SST and DST and transfer lines between the DST and 242-A&S evaporators and the Waste Treatment and Grout Treatment Facilities); and (3) the Replacement

Transfer System between the East and West area (W-058), which will connect the East Area DST to the new DST, a distance of 6.5 miles. The 6.5-mile pipeline is needed because only two of the six transfer lines are presently operable. These two transfer lines are too small to handle sludge suspensions and do not meet either Washington State or DOE specifications. Some TPA milestones depend on transfer between the areas. The design of the system appears to be well-thought out and should be a very serviceable system. The design should include the ability to test the extrados (the inner surface of a bend) of the stainless steel pipe for erosion in the high-velocity regions of the pipe bends because sludges, especially aluminas, can be erosive. Another option is to use strips in the extrados that are removable for erosion measurement.

Cathodic protection for the outer carbon steel pipe of the double containment piping system could create a corrosion problem if the spiders separating the two pipes are electrically conductive and electrical leakage occurs through the stainless steel pipe to ground. The design and insulating material for the spiders should be carefully considered and chosen based on advice from a cathodic protection specialist.

C.4.C. Seismic Criteria

SSTs were designed and constructed according to the criteria in effect at the time of their construction, before the introduction of seismic criteria. DSTs constructed between 1973 and 1986, designed and constructed to meet the requirements for a 0.25 g seismic event, have been evaluated for waste with a sp gr of 1.2 to 2.0. To evaluate the seismic qualifications of the SSTs, one-million-gallon tanks in Tank Farms 241-A and 241-AX were analyzed for the 0.25 g seismic event with a full tank of 2.0 sp gr waste. The 758 000-gallon and the 533 000-gallon tanks were seismically evaluated by their comparison to and similarity to the one-million-gallon tanks. In their presentation, WHC told the subpanel that analysis of the smaller tanks was not necessary because comparison to the one-million-gallon tanks demonstrated that the 758 000-gallon and the 533 000-gallon tanks were seismically qualified. The 55 000-gallon tanks were evaluated separately. Information presented to the subpanel by WHC personnel showed that the seismic response spectra used in constructing the DSTs and in evaluating the SSTs is more conservative than present design requirements (Becker, 1992).

In the event of a design basis earthquake, the steel in the primary liner of the DSTs could be stressed to near to or in the excess of the yield point. Such a situation might introduce stresses that, in turn, might lead to stress-corrosion cracking of high-temperature tanks out of compositional limits (the waste tanks were stress relieved during construction to remove residual stresses, thus preventing stress-corrosion cracking). The subpanel realizes that the occurrence of such a seismic event is unlikely; however, since stress-corrosion cracking can cause a waste tank to leak in a relatively short period of time, this possibility must be considered.

C.4.D. TRAC

The TRAC program consists of several different subroutines that model chemical and physical processes in the SSTs. Records used in the TRAC program are incomplete but do contain the best available records about tank contents and waste transfer. As core characterization proceeds, the subpanel believes that the TRAC database should be updated. The information would also prove valuable when grouping tanks into various categories for safety issues, pretreatment, and retrieval (Simpson, 1992).

The ancillary issues and facilities review included the analytical laboratories and related equipment, LIMS, sampling, storage and archiving, spatial variations in tanks, and outside laboratory work.

C.5. Analytical Capability

C.5.A. Characterization

Chemical analysis capability has replaced core sampling as the limiting factor in the characterization of tank contents. The characterization of each segment of a core has become better organized. Values obtained from these analyses are being compared with data from TRAC to improve their accuracy. Grouping the tanks according to their chemical composition may decrease the time necessary for tank characterization because of a reduction in the total number of analyses required to develop an estimate of tank composition for similar tanks.

Many groups have indicated that waste characterization at Hanford is a problem. For example, the ITR report on the Hanford Waste Vitrification Project (HWVP) (DOE-EM-0056P) stated that the 200 Area analytical facilities should be expanded so that their 1994 annual capacity would be four to five times that of their 1991 annual capacity. The Regulatory subpanel identified delays and uncertainties in the permitting process resulting from insufficient and untimely waste-characterization capability. However, WHC personnel presented information indicating that they will attain the projected analytical sample load by 1996 and will be current with the backlog by 1998.

C.5.B. Work Load and Capabilities

The TPA defines many analyses and schedule requirements for the tank waste. Consequently, the laboratory schedule appears to focus on meeting these TPA milestones by using samples from the tank characterization activities. Many view the rate at which the analytical laboratories can perform and document these analyses as the limiting factor in meeting the TPA milestones. That tank sampling is no longer the limiting factor for waste characterization is due to a well-defined and implemented effort, including development of a mobile sampling truck. A similar effort focused on efficiently utilizing the available analytical facilities and personnel to partially alleviate envisioned analytical constraints.

To quantify the effort required to characterize cores and other samples, the concept of an Analytical Equivalent Unit (AEU) was developed. One AEU is defined as the laboratory effort expended to characterize and document the data from one core consisting of five segments from Tanks. The AEU concept is proving to be valuable in establishing data quality objectives (DQO) and allocating laboratory capacity. The current projected annual capacity for the two analytical laboratories (222-S and 325) is 24 AEUs (Table III) (WHC-EP-0533) with an achieved rate of about 21 AEUs in 1992. It appears that the laboratories will not be able to meet their projected capacity for this year and that analytical throughput projections are overestimated. The ability to dispose of waste from the analytical facilities is a major issue. For example: (1) the 325 laboratory could not be used to analyze waste samples for over one-half of 1991 because of permit problems, and (2) the 222-S laboratory operations were curtailed in mid-May because the laboratory could not send liquid waste to the tank farm because of the criticality safety question in the tank farms (Bell, personal communication).

Table III

Analytical Laboratory Projected Core Analysis Capacities

Fiscal Year	222-S (AEU)	325 (AEU)	Total (AEU)
1992	12	12	24
1993	22	18	40
1994	30	24	54
1995	50	30	80

Projections for future analytical capacity relating to TPA milestones and tank-safety concerns apparently used *idealized* criteria that assumed full funding was available and did not account for facility expansion delays. Under any other assumption, delays will be inevitable in the tank-safety program and TPA milestone slippage. If the time lines are too optimistic (or unrealistic), improper prioritization of resources can result. If a milestone cannot be realistically met, the planning should develop alternate plans.

Additional facilities and manpower may not be the only answer to the demand for more analytical capability. Reducing the number and types of analyses, relaxing the data precision requirements, and negotiating with regulators for less stringent analysis and documentation requirements could effectively increase the throughput. One example of possible improvement is a backup for the lone chemist who is running some of the more sophisticated analytical equipment.

The projected analytical loads presented to the subpanel indicated a very large growth followed by a decrease in demand for analytical support. The subpanel questions any substantial reductions in analytical loads unless some of the proposed changes are implemented. The projected analysis requirements presented to the subpanel did not show an increase in uncertainty with time, as would be expected. The subpanel expects that these uncertainties must increase concomitantly with time increases.

A single core from 101-SY will consume over 20% of the combined annual capacity of the 222-S and 325 laboratories. The subpanel was concerned that the entire 101-SY program did not have a well-defined end or cut-off point. As soon as new core samples reveal no new information, the 101-SY sampling program could be curtailed.

C.5.B.1. Facilities and Personnel. The 222-SB filter plenum deterioration and lack of hood space in 222-S appears to restrict expansion of capabilities in the near future. Currently the June 1994 start up of the 222-SB hot cell appears to be threatened because the laboratory is waiting for congressional approval of additional funding ($2.9M) for the 222-S HVAC plenum upgrades. Hot cell construction is proceeding but the hot cells cannot be used without this filter plenum. Should the delay become a reality, the laboratory capacity and the ability to meet the TPA milestones will have to be reevaluated. The possible delay in approval of funding for the plenum upgrades further indicates a failure of WHC to take an integrated approach to the analytical capability problem.

The Integrated Sampling and Analysis Plan (March 1992) states: "A larger portion of the 222-S Laboratory and PNL Analytical Chemistry Laboratory resources could be dedicated to the support of the >10 mrem/hour programs than is currently allocated." If the capacity is available, the subpanel feels it should be utilized if, indeed, the core-sampling effort has a very high priority.

The Plutonium-Uranium Extraction (PUREX) laboratory has been proposed as a potential supplement to the 222-S and 325 laboratories. After discussions and reviewing the available documentation, the subpanel believes that these laboratory facilities would provide capability for miscellaneous analyses and training but not for core analyses. The upgrades required and the shut down of the uncertain infrastructure of the PUREX facility makes a long-term commitment to the facility questionable. However, the PUREX laboratory could be used as an alpha laboratory, for research and development (R & D) activities on procedures or methods for use in the 222-S or 325 laboratories, or for other similar functions. Rather than delay routine analysis procedures and methods, R & D activities should be given to another laboratory (or part of a laboratory) having that responsibility. Currently, R & D activities and the core analyses are carried out in the same laboratories, hindering the prioritization of either effo: (R & D versus core analyses).

The FMEF building may provide a long-term solution (after 1998) to laboratory space and throughput needs but appears to provide little near-term relief. The building is well-suited for conversion to a laboratory because of the available utilities and space. However, the subpanel was informed that the planning effort for the project is to be reduced by about 50% for the coming year, which could result in a longer time before the facility would be usable. If the facility is to be operational in a timely manner, adequate resources must be dedicated early to ensure that the planning is thorough and that few delays or surprises are encountered.

Office and laboratory space for personnel is in short supply. Although competent, qualified individuals are hired, keeping personnel is difficult when space is marginal. Management at PNL told the subpanel that some of the 325 laboratory personnel are being supported on overhead because of funding shortages. The subpanel is concerned because such an arrangement provides little stability for attracting and keeping qualified personnel in critical operations. For ongoing projects (such as core sample analyses), resources should be secure so that the project as a whole can be more stable and more effective.

The lack of analytical chemistry facilities and resources for WHC personnel to carry out developmental activities is a major area of concern. A large fraction of the tank-waste analyses is considered to be developmental because of the complex equipment and trained personnel required to run the specialized analyses. In addition, PNL is scheduled to analyze about one-half of the core samples taken from the waste tanks. Integration of R & D activities performed by WHC personnel into their analytical facilities would be very advantageous. A secondary advantage would be the feeling of ownership and long-term commitment that is conducive to maintaining a good working relationship.

The lack of facilities on the Hanford site, operated either by WHC or PNL, to carry out basic developmental studies is potentially a more important area of concern. For example, because most of the basic research work on the hydrogen and ferrocyanide problems cannot be carried out on the Hanford site, the work must be sent to research facilities at LANL, Georgia Institute of Technology, and Argonne National Laboratory. Performing more of these activities at Hanford would maximize the knowledge available on the site.

C.5.B.2. <u>Equipment</u>. The planned upgrades of equipment show only a few line items for large equipment (such as inductively coupled plasma (ICP) and LIMS). The ICP is apparently not needed to reach the TPA milestones because it does not have a necessary implementation date (WHC-EP-0533). If this is correct, the ICP should be placed at a lower priority and be replaced by other equipment that is essential for meeting the objectives of the laboratory. However, analytical personnel at SRS state that ICP is their real "work horse."

Thus, it appears that the ICP may be more important for the long term than Hanford has indicated. It appears to the subpanel that other equipment should be required, given the large increase in sample load.

The use of automated sample identification (bar codes), autosamplers, and other automated equipment should receive a high priority during the upgrade planning because such equipment can greatly increase throughput, improve record management by implementing LIMS, and minimize the manpower and large equipment expenditures required.

C.5.B.3. Documentation-LIMS. The level of documentation required by the TPA is very complete and very time consuming. The LIMS is projected to be completed by June 1995. In the interim, the laboratory must generate all required documentation manually or on individual computers and perform sample tracking manually. Increased emphasis should be placed on obtaining an on-line automated documentation system–LIMS–as soon as possible to reduce the effort now spent in preparing documents.

C.5.B.4. Off-site Analysis. The Hanford analytical laboratories are continuing to investigate the possibility of using outside laboratories to perform analyses. The subpanel was told that approximately 99% of all environmental protocol samples <10 mrem/hour (which includes most Resource Conservation and Recovery Act (RCRA) and Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) analyses) are contracted to outside laboratories. Little gain is expected in those areas; remaining samples on site, such as air monitoring samples, require a quick turnaround. Off-site laboratories are being used where possible to increase capacity.

The subpanel was told that about 30% of the analyses are high-level samples that must be analyzed on site. Two problem areas presented in using outside laboratories for highly radioactive samples (>10 mrem/hr) are the limited number of laboratories capable of performing these analyses and transportation restrictions. The first problem area cannot be resolved quickly. For example, some laboratories that are capable of completing most, if not all, of the required analyses do not have the necessary shielded facilities. In the second area, the transportation organization for WHC can handle shipment of virtually any samples if the sampling/analytical organizations will coordinate all sample movement through them to ensure meeting all regulatory requirements. Identification of analyses that can be done off site should continue. For example, an effort is being made to have SRS analyze for concentrations of noble metals, which is important for glass-melter design and waste compatibility.

C.5.B.5. Storage and Archiving. The need for archiving core samples from the waste tanks for subsequent study is well understood, but the interface between sampling and the responsibilities for archiving has not been well defined. A clear definition of responsibilities, storage requirements, and storage times must be established before facilities can be effectively utilized. In addition, the group requesting the sample archiving must provide resources to the archiving organization (the sampling group, the analytical labs, or some other designated organization) (WHC-EP-0533).

Storage locations currently in use, such as the 327 laboratory, should be evaluated to determine whether they can be utilized for archiving core samples. If the number of samples not requiring long-term storage is reduced, more room would be available for more current samples.

C.5.B.6. Sampling. The coordination effort between the sampling and the analytical laboratory groups is improving. A flowchart has been initiated that defines the process from sample request to analysis and data disposition, thus avoiding duplicate effort and facilitating the process. The consolidation and coordination effort should be studied for possible expansion to include other functions involving the analytical laboratories. The idea that the analytical labs will have one focal point as their customer should greatly assist in streamlining the operation, as well as ensuring that the necessary budget, facilities, and personnel are available to provide the analyses.

To efficiently utilize laboratory capacity, efforts to define DQOs for core analyses are beginning and should be continued. The DQO is an agreement between process personnel and analytical laboratory personnel that specifies the quantity and quality of data required, the use of the data, the expected analysis time, and the cost. The required accuracy and level of documentation is also specified. There must be a balance between requests to analyze each core segment for all possible chemical and physical properties and the number of cores to be analyzed. Laboratory capacity, analysis time, and cost are important factors. To minimize the laboratory's work load, the DQO must be thoroughly examined before requesting analyses from the laboratories to ensure that only the data and accuracy needed are being requested. The subpanel perceived that this type of dialog is beginning.

C.5.B.7. Spatial Variations in Tank Waste. According to material presented to the subpanel, spatial variations in tank waste have been studied in Tank 110-B. Seven core samples from five risers were taken and analyzed. The effort to quantify the concentration variations for chemical components found in tanks appears to be statistically sound. In addition, a Kriging model based upon an auto covariance function was developed. The auto covariance function has three degrees of freedom and thus requires a minimum of four core samples from different risers to independently construct the Kriging mode in each tank. However, once an adequate auto covariance function has been determined for a group of tanks, fewer than four core samples from a tank are required to implement the Kriging model. However, sufficient data to construct and verify an adequate auto covariance function is not presently available.

The most detailed study was performed on Tank 110-B. That this tank is representative of the other tanks must be verified before the assumption that four core samples are adequate can be extended to the other tanks. However, if families of tanks can be identified that are similar in contents and form, the number of analyses may be reduced by presenting arguments (including supporting data from TRAC) that detailed analysis on each tank is unnecessary.

If the Kriging model predictions are to be used for waste characterization programs (such as regulatory compliance demonstration), to design pretreatment processes, or for other applications, a study must be carried out to define the level of confidence or accuracy necessary for chemical component concentrations to be able to support the other activities. Although some activities may require very accurate data, others may require less precise values where the Kriging model would be adequate. For example, should an activity (such as criticality, regulatory compliance) require quantification of constituent concentrations to an accuracy better than that achieved by the Kriging model, further analytical work must be performed before or during remediation to reduce the uncertainties. Thus, the applicability of the model data to various programs must be determined. In general, the more accuracy required, the greater the cost or time or both required for the analysis. In all of these activities, personnel involved should be cognizant of the analytical capabilities available.

C.6. Ancillary Processes

C.6.A. Pretreatment

Integration of SST and DST retrieval, remediation, and disposal missions into a single Hanford site tank-waste disposal plan is currently underway. Pretreatment may also be necessary to resolve tank-safety issues. A pretreatment step must be used to prepare some of the waste for final processing into the reference glass-waste form and into grout.

The waste in the tanks is present as one of three types: salt solutions, water-soluble salts, and water-insoluble sludges. The liquid phase in the tanks contains high concentrations of soluble salts and much of the radioactive cesium. Although the water-soluble salts are associated with low levels of radioactivity, radioactive cesium trapped in salt crystals during the solidification processes is found in the salt that precipitates from solution. Although these crystals can be very hard, they are easily dissolved. Most of the radioactive material, including the transuranic waste, is in the sludge. The sludge must be processed in a pretreatment step before vitrification. Different processes and operations have resulted in several types and amounts of sludge in the Hanford SSTs and DSTs. Even after extensive water washing, most of the sludges contain various amounts of sodium compounds. Some of the sodium compounds are only slightly soluble in water (for example, $Na_2U_2O_7$ and sodium aluminosilicate), whereas others represent soluble sodium salts that are incorporated into insoluble metal precipitates.

A three-phase strategy, comprising near-term, intermediate-term, and long-term phases, is proposed for pretreatment and disposal of radioactive waste at Hanford.

C.6.A.1. Near-Term Phase. The near-term phase consists of waste pretreatment by sludge washing, either in existing DSTs or in one of the planned new DSTs, and cesium separation by ion-exchange in the pretreatment facility. This processing approach will be applied to neutralized current acid waste (NCAW) and other chemically similar alkaline PUREX wastes, such as the sludge heel in Tank 101-AY and the high-heat waste in Tank 106-C. Fifty-nine SSTs have been identified for evaluation for pretreatment by sludge washing. Feeding waste from one tank or one waste-type at a time will probably maximize the variables in feed to the vitrification plant.

Although Hanford personnel state that sludge washing is a proven technology and is not a problem for NCAW, the sludges in some tanks containing cyanides and concentrated organics may require much more complex technology for initial pretreatment. A review by the NRC categorized double-shell slurry (DSS) and double-shell-slurry feed (DSSF) as low-level waste (LLW). Based on this ruling, WHC has planned to add the supernate and sludge washes directly to grout. Because the grout produced at Hanford contained a high concentration of ^{137}Cs, the states of Washington and Oregon submitted a petition to the NRC requesting a ruling to require the removal of the largest technically achievable amount of radioactivity before grouting. Such a ruling by the NRC would mean that some or all of the DSS/DSSF wastes will require pretreatment, which could have an impact the availability of tank space needed to perform pretreatment operations. Moreover, ion-exchange facilities would be required to remove ^{137}Cs; other pretreatment facilities would be required for removal of hazardous chemicals. Thus, an NRC ruling to remove a maximum amount of radioactivity would stop sludge washing and grout production until the cleanup facilities presently proposed for the pretreatment plant are in operation, which is projected to be about in the year 2007.

C.6.A.2. Intermediate-Term Phase. The intermediate-term phase will focus on development of technologies that are more efficient than simple sludge washing for separation of wastes. The principal technology being considered is in-tank sludge washing/inert dissolution, which consists of removing the soluble constituents by sludge washing and dissolving most of the inert constituents that limit the waste loading in glass. Sludge washing, followed by blending in the waste tanks is an alternate approach. A third approach is selective leaching of transuranic components from the sludge using acidic and/or alkaline leachants in new stainless-steel tanks. WHC is investigating alternate pretreatment processes that will efficiently separate tank wastes into feed streams acceptable for feeding to the vitrification process and grout.

C.6.A.3. Long-Term Phase. Long-term development of technologies for pretreatment of some the wastes are very complex. The technologies being considered include the advanced separation processes Transuranic Extraction (TRUEX) for actinides, strontium extraction (STREX), and a process for cesium [WHC-EP-0511]) and reactions with the organic constituents in the waste.

The level of development required before implementation is one of the most significant uncertainties associated with advanced chemical separation technologies and organic destruction. About seven years for additional process development is required after the decision to install these processes as part of a new pretreatment facility. A previous technical review panel concluded that technology development could achieve the goal of an operational TRUEX facility by the year 2000 (DOE/EM-0056P; presentations to the ITR Team by WHC and PNL Personnel, 1991).

C.6.B. Grout

Grout, a cement form of waste, is the wasteform selected for permanent disposal of low levels of radioactivity at Hanford (WHC-SD-WM-RD-O19, DOE/EM-0056P, WHC-EP-0511). This waste form must meet regulatory requirements for mechanical strength and leachability, and technical requirements for thermal stability and radiation stability. Some of the tank wastes contain organic materials that, if mixed with the grout-forming materials, must be evaluated against regulatory limits and the technical capabilities of cement-based waste forms before disposal; therefore pretreatment of the aqueous waste stream being fed to grout will be necessary to meet regulatory and technical acceptance criteria.

The physical and chemical acceptance criteria for the low-level radioactive liquid and sludge wastes in the DSTs and SSTs are defined in report WHC-SD-WM-RD-019. This document is based on the Code of Federal Regulations as well as on DOE ORDER 5820.2A, which state that such LLW can have up to 100 nCi/g of transuranic waste. Previous ITR Team reports stated that the Hanford strategy for removal of radionuclides from LLW fed to the grout facility is inconsistent with practices at SRS and West Valley. The process used by SRS and West Valley removes much more ^{137}Cs (decontamination factor 4 000 to 50 000) than is removed by the Hanford process (decontamination factor ~20), thus the grout produced at Hanford has a ^{137}Cs concentration much higher than that produced at SRS and West Valley. If the NRC reverses its previous position and rules in favor of removal of the maximum technically achievable amount of radioactivity before grouting (as requested by the states of Washington and Oregon–see Section C.6.A.1.), pretreatment of some or all of the wastes from the SSTs and DSTs will not only have an impact on the availability of tank space but also significantly delay the grouting program. The capability to remove ^{137}Cs

(not other radionuclides of interest) from the feed to grout will not be available until about 2007, assuming that ^{137}Cs ion-exchange capacity would be located in the pretreatment facility.

Continuing technology development is necessary to support the disposal of LLW into grout. About one year is required to formulate and demonstrate an acceptable grout for each waste type. Blending of the wastes to produce fewer waste types might be useful if tank space for blending is available. Alternate forms are being investigated for disposal of LLW.

The subpanel is also concerned about the very thick asphalt coating (40 inches thick) on the exterior of the grout vaults that may have the potential of releasing several thousand gallons of volatile organic compounds (VOCs) into the ground. The high temperatures, approaching 90 $^{\circ}C$, expected in the grout vault (estimated temperatures in the asphalt are lower) would contribute to this release. The total volume of asphalt was calculated using the internal dimensions of the vaults, the wall thicknesses, and the asphalt thickness, then reduced to the volume of asphalt tar using the reported compaction of the asphalt (within 4% void volume) and the asphalt tar content (reported to be 7-8%). The gallons of VOCs are estimated by assuming that the tars contain 5% volatile and semivolatile organics (this figure may be inaccurate but is a reasonable estimate) (WHC-SD-WM-RD-019, PNL-6148-UC-70B).

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APPENDIX D

PROCESS ENGINEERING SUBPANEL ASSESSMENT

D.1. Review Process

The objectives of the Process Engineering subpanel review were to (1) examine and evaluate the configuration, operation, and control of the Hanford tank farms and ancillary facilities (evaporator, effluent treatment and disposal systems, transfer lines), as these components are currently managed; (2) verify that all wastes are being stored, treated, and monitored in a safe and reliable manner; and (3) determine if technically sound program planning exists to continue safe waste storage and the handling at these facilities and to provide a facility and waste form that is compatible and integrated with the remediation methods that will be implemented eventually at this site. Issues that were addressed by the subpanel include but are not limited to the following:

- *Are day-to-day operations performed according to technically sound, practical, and monitored practices that ensure safe conditions at all times?*

- *Have tank-farm risk-reduction programs been developed to respond to immediate safety concerns, as well as to long-term and remediation-related considerations?*

- *Are tank-waste-volume projections developed in a comprehensive and technically defensible manner that adequately supports decision making throughout the tank-waste system?*

- *Does the retrieval-technology-development program adequately consider both emergency retrieval and treatment-process development requirements?*

- *Are tank-farm-related process-engineering activities integrated with all other components of the TWRS?*

D.2. Summary of Findings

The problem identified by the subpanel as being of greatest and most immediate concern is that the continuing degradation of the physical condition of the tank farms will prevent operations personnel from being able to respond effectively to a breach of tank containment. Prompt discovery of a tank leak is unlikely because much of the monitoring instrumentation is disabled and unreliable. The newer DSTs have multiple automatic and manual indicators of tank leakage. However, the subpanel received the impression that there have been occasions when all the automatic indicators on a DST were out of service. Moreover, if a leak was identified, the leaking tank(s) probably could not be pumped out. Inoperable pumps, unusable transfer lines, and waste compatibility problems make much of the putative spare tank space inaccessible. Limited planning, lack of reliable information and documentation, and inoperable equipment and instrumentation hinders confident, timely decision-making in an emergency, so that an over-reaction to problems is often necessary. The existing surface contamination and access restrictions impede any response options involving field work. The continued degradation of field equipment is increasing the risk and further limiting response options.

The subpanel had the impression that the poor physical condition of the facility and infrastructure hinders and sometimes precludes adequate day-to-day control of tank-farm operations. The monitoring of conditions within and around the tanks is a highly convoluted operation. Many automated and manual systems and several poorly integrated organizations are responsible for acquiring and reviewing data. Many instruments are non-functional. Because functioning instruments are often uncalibrated, the quality of their output is questionable. Monitoring data are useful only for gross indication and are not adequate to observe all tank conditions identified as necessary for safe operations. Similarly, absence of a correct, reliable document infrastructure (such as technical drawings, equipment specifications, safety equipment lists) prevents an understanding of the hardware and control systems. In addition, operational conditions appear to be declining. The burden of administrative requirements and paperwork, from managers to engineers and operators, has almost halted facility improvements. The administrative burden and the magnitude of the problems have diverted the attention of much of the management and staff from the seriousness of the day-to-day problems in the tank farms.

Hope for future improvement lies with the quality of personnel, the maintenance of generally good internal working relationships despite difficult conditions, improved training of operators, and programs to provide additional administrative and technical support to operations management.

D.3. Problems Associated with Performance of Operations

D.3.A. Job Control System (JCS)

Despite general complaints, a consensus prevailed that fundamentally the JCS was a good idea but difficult to implement in a facility as deteriorated as the Tank Farms. Several WHC employees stated that the method of classifying "Safety Class Items" is a major problem. Employees are becoming frustrated with the system. Difficulties in implementing the JCS are causing some employees to develop methods to circumvent the system. This is a bad idea: if the organization is not working, it should be improved rather than be ignored.

The current maintenance program mandates the use of a safety classification and configuration management procedure (WHC-SD-WM-PLN-

028, Rev. 1) that effectively mandates the piecemeal upgrade of systems to the appropriate safety classification as components fail and are repaired or replaced. This approach is creating a situation in which the time, effort, and funds being used to partially upgrade all systems is consuming resources to an extent that precludes the complete upgrade of any system, within current budget constraints. In fact, the delays caused by such upgrades (including the time required to reestablish portions of system configuration and to procure safety class items) appear to have increased repair times to the point that equipment is failing more rapidly than it can be maintained, decreasing the overall availability of equipment at the Tank Farm.

Section 5.4.2. of WHC-SD-WM-PLN-028, Rev. 1, mandates that an interim safety classification of components be performed when equipment is repaired, replaced, or modified and the safety classification is unknown or suspect. Section 5.4.3. of this procedure mandates that a similar interim safety classification of parts (designated as a determination of the impact level in tank farm terminology) be performed when they are repaired, replaced, or modified and the safety is unknown or suspect. Although the latter section permits parts to be assigned a safety classification (impact level) that is different from the safety classification of the parent component, we were informed that the engineering organization, in an effort to eliminate the analytical and paperwork burden associated with justifying such differences, has mandated that parts shall always be assigned an impact level that is the same as the safety classification of the parent component.

Because adequate and current SARs for the tank farms and other facilities are generally not available, there is no DOE-approved technical basis for the assignment of systems and components to safety classifications. Furthermore, because this interim safety classification is done on the basis of an individual component or part, the entire system will be upgraded to the proper safety classification only when all components have been repaired, replaced, or modified.

Thus, the Hanford Waste Tank Farms are spending considerable time, effort, and funding on the upgrading of portions of systems to safety classifications for which there is no DOE-approved technical basis. Section 5.3.2 of WHC-SD-WM-PLN-028, Rev. 1, mandates that the interim safety equipment lists be replaced by safety equipment lists as the technical bases for such lists (for example, DOE-approved upgraded SARs) are developed. Therefore, the safety classification of all systems, components, and parts that have been classified on an interim basis will need to be revisited as the sup[porting SAR upgrades are completed and approved by DOE (FY 95 and beyond). All of this means that the current piecemeal upgrade process, mandated by WHC-SD-WM-PLN-028, Rev. 1, is unlikely to succeed before the year 2000 to completely upgrade even a single safety-related system to a safety classification for which there is a DOE-approved technical basis.

We have not seen evidence of a structured approach for upgrading entire systems to the appropriate safety classification, including a defensible method for assigning priorities to and the scheduling of such upgrades. For example, the discussion of capital upgrades in Section 6.2 of the Tank Farms Upgrade Program Plan (WHC-EP-0392) does not specifically address the upgrading of all safety class equipment for any specific tank. Similarly, our review of the systems upgrade planning does not indicate that there is any coordination of the planned systems upgrade activities with the *ad hoc* upgrading of components as maintenance is performed. Furthermore, during almost all of our interviews with personnel responsible for maintenance, we were informed that compliance with WHC-SD-WM-PLN-028, Rev. 1, was the greatest single impediment to rapid repair of safety-related equipment. Information gathered by other ITR members indicated that the pace of repair has fallen behind the rate of equipment failure, to the extent that the physical condition and operability of tank farm equipment is deteriorating rapidly.

WHC should establish a structured approach for upgrading entire systems to the appropriate safety classification, including a defensible method for assigning priorities to and the scheduling of such upgrades. The approach should be integrated with the development of SARs. The configuration of waste-tank safety systems should be documented and brought under control sufficiently early in the safety analysis process to ensure that all structures, systems, and components described in each SAR are described correctly and will function as relied upon in the analyses of accidents and normal operations. Each safety class structure, system, or component should be upgraded to the safety classification mandated by the results of SAR analyses. Those structures, systems, and components determined through the SAR analyses not to be safety class (WHC safety classification/impact level 4) do not need to be upgraded from commercial class components. Full application of WHC-SD-WM-PLN-028, Rev. 1, should not begin until the configuration of the Waste Tank safety systems has been documented and brought under control. Until the system configuration is documented and brought under control, the repair or replacement of components or parts should not require an interim safety classification. Rather, an abbreviated review should be performed to verify that: (1) the repair or replacement of the item will function as well as the item repaired or replaced (for example, replacement of a commercial grade item with a commercial grade item), and (2) that the failure of the repair or replacement item will not pose and greater hazard than the condition that is being repaired. (If the latter cannot be validated, an interim safety classification review should be performed.) Some of the resources made available by reducing the level of engineering review required to perform corrective maintenance should be used to accelerate the schedule for the development of SARs so that the system level upgrades of those systems that make the greatest contribution to limiting risk can be completed in the near term.

D.3.B. Audits and Evaluations

On a single day, the Red Team and three other evaluation teams were on site. At times we were unable to contact specific WHC individuals because they were involved with another team. Review teams allegedly consume about a third of the time of WHC staff, which if true, has a significant impact on the operation of the facility.

D.3.C. Paper Work

The Process Engineering subpanel had the strong impression that technical personnel were busy with so much paper work that they devoted little time to developing technical solutions to problems in the tank farms. Engineers estimate that about 75% of their time is devoted to administrative tasks, and operators spend 25% to 35% of their time on paperwork.

D.3.D. Tri-Party Agreement Programs

Because the TPA was made before many of the technical problems had been completely evaluated, it specifies several operations that probably cannot achieve the schedules specified.

D.3.E. Immediate and Long-term Problem Solving

Several tanks have interesting technical problems, including hydrogen generation and possible interactions between ferrocyanide and nitrate. A major amount of time and funding apparently has been spent evaluating these tanks, to the detriment of other more ordinary but significant everyday problems. The subpanel heard evaluations indicating that the ferrocyanide tanks are not a problem if the waste is kept damp. Mechanical mixing of the contents of major hydrogen-generating tanks is expected to prevent episodic releases of hydrogen. These problems should be solved or alleviated quickly. The focus can then shift to handling future leaking tanks, where serious problems exist in the ability to transfer liquids from leaking tanks, and in methods for monitoring tanks.

D.4. Problems Associated with the Emergency Response Plan

D.4.A. Background

The Emergency Response Plan ((WHC-SD-PRP-TI-001), although only in the initial stages of writing and implementation, appears to be · ell thought out. The plan requires considerable coordination among groups, and this function has been identified. Nevertheless, communication among groups may present problems; the current plan is to use cellular telephones with a special channel devoted to emergency communications. A single person is writing the Emergency Response Procedures for the tank farm, including setting up the logic train, specifying responsibilities, writing procedures and checklists, training, drills, and other procedures. Considerable training is planned with major emergency drills scheduled every quarter and minor (localized) drills at a rate of four per month (one per shift).

A specific milestone for completion of an Emergency Response Plan for the tank farms has not been set. To complete procedures and check lists for the entire tank farm area is estimated to take until about the end of CY 93. The procedures and check-lists for the 242-A area will be prepared by July 1992, and training of personnel will be completed during July and August. All affected parties (Health Physics (HP), Security, Operations, and others) review the procedures and check lists. A fast turnaround (two weeks) has been requested to facilitate the development of the system. All personnel required for each responsibility have been identified and informed; three employees are assigned to each critical responsibility to ensure that someone is available. A problem exists during off-shift times. More people should be on-call to properly staff the system in an emergency.

D.4.B. Operations' Attitude

The Operations organization of the Tank Farms is reluctant to place sufficient emphasis on the Emergency Response Plan, apparently viewing Emergency Response as something that distracts from other responsibilities. The subpanel judged that Operations is unable to respond effectively to a major emergency.

D.4.C. Instrumentation System

A major tank leak is the most likely event that would require an emergency response. The ability to rapidly detect such a leak depends on the particular tank farm. The DSTs have six systems, of which five are automatic, to detect a leak. The SSTs depend primarily on the conductivity probe which is only effective if it is in-service and if there is a liquid surface. For SSTs that have been stabilized, the leak detection system depends on a liquid observation well (LOW) or radiation monitors in the dry wells surrounding the tank or in two tank farms, a system of lateral drywells beneath the tanks. One aspect of the tank upgrade program is the replacement of conductivity probes with radar-type level instrumentation. The ability to detect a leak in a DST is good although the subpanel was told about occurrences where all the redundant systems in a DST were out of service or out of position. The instrumentation for the SSTs is much poorer and much of it is inoperable. It is quite likely that a leak could go undetected in the SST for some time before being detected.

With one exception, all the level detectors are of the conductivity type. Problems with conductivity-type detectors were mentioned, especially growth of stalactites from the tip making location of the liquid level difficult. The new level detectors will be radar-type instruments that should not have this problem. Installation of these monitors on the unstabilized SSTs that have liquid surfaces should have a high priority. LOWs should be installed where there is no liquid surface to monitor the interstitial liquid after stabilization.

Changes of temperatures or temperature profiles within a tank could signal other problems. Problems in temperature monitoring include the following: (1) present thermocouples are generally about 40 years old and in poor physical condition; (2) cannot be certified or calibrated; and (3) at least one-third of all thermocouples are not functioning or cannot be monitored at any given time (see Section D.5.A.). Installation of new thermocouple trees should be expedited for tanks having a potential for temperature excursions.

D.4.D. Vapor Inhalation Incidents

Problems involving noxious gases released from various tanks have been met; sometimes personnel have sustained lost-time injuries. The gases have not been completely identified and monitoring systems are absent. A study conducted in 1989 identified 51 incidents of worker injury due to vapor inhalation that had occurred in C, BY and TX Tank Farms from 1957 to 1989. Injuries varied from minor problems requiring only first aid to more serious occurrences requiring hospitalization. Apparently several tanks have been identified as frequent sources of problems. For example, Tank 103-C emits organic vapors at a concentration which routinely disables the HEPA filters on its ventilation system. Filters on this tank typically have to be replaced at a rate of seven times per year. This rate is significantly greater than that for any other tank. Even with a large store of analytical and empirical data on vapor releases from the tanks, WHC continues to treat each instance of vapor inhalation injury as an isolated incident and has not attempted to develop a comprehensive mitigation and response plan to resolve this problem. Because of the potential problems with emitted gases, workers use air suits, greatly limiting the work that can be accomplished by the staff; this will become a very major problem in the summer as temperatures increase. It is likely that personnel will be limited to between 15 and 30 minutes of effort in an air suit unless they carry a cold pack.

D.4.E. Limited Transfer Capabilities

Two submersible pumps and two jet-transfer pumps are currently available to remove liquid from a tank in case of a leak. Three years have elapsed since HTFO has had to pump a leaking tank. Since the previous average was one leak per year, the subpanel feels that a leaker is overdue. Most of the transfer lines are singly contained; they are not to be used in normal operations but can be used in an emergency to transfer tank contents. The lines are tested before use at 200 psi (4 times the required transfer pressure) for leaks. A material balance is performed on the leaker and on receiver tanks during a transfer, and alarm monitors are positioned along the transfer line to detect leaks. Before the transfer, two samples are removed from the tank: one for determining the contents and assessing which receiver tank can be used without mixing incompatible waste types, and the other for RCRA records. WHC expects the leak rates to be low and feels that a delay of a few days for response is of small technical significance. Forty-four of the SSTs are not interim stabilized and would have to transfer significant volumes of liquid in case of a leak. One of these tanks does not have an operable underground line for transfer to another tank. Twenty-six SSTs have only one underground line; some lines would not be usable. Above-ground transfer would be an alternative, but the existing Safety Analysis Report (SAR) does not adequately cover this possibility. However, the SAR update effort has been postponed because it fell below the cut-off point on priorities. The update, which would cost only $100K, will probably not be completed for 18 months, as currently prioritized. Most of the equipment needed for above-ground pumping is being procured, but the actual piping cannot be fabricated until the design is incorporated into the SAR and approved. Thus, a legal removal of free liquid from a leaking tank that does not have an intact underground line might not be possible until CY 94. If above-ground transfer were used, the tank contents would be pumped above ground for a maximum of 300 ft before entering a pump pit where the flow would be directed to the desired tank; the remainder of the transfer route would be through proven underground lines.

The subpanel could not get a consistent answer about the number of usable cross-site (i.e. from East Area to West Area) transfer lines. Some WHC sources claimed that two lines were available, but others stated that only one line was not leaking or plugged. Since at least four other cross-site lines have failed, the condition of the remaining two is considered marginal at best.

A report detailing how transfer from each tank would be accomplished has been published (SD-WM-AP-005). The actual utility of the plans identified in this document were questioned by the reviews since many of the transfers relied on equipment and transfer lines that would not be available.

D.4.F. Accessible Tank Space.

Although spare DST capacity is maintained for emergency response, much of the space was found to be inaccessible from many of the tanks that have leak potential. For example, almost all spare tank capacity is in the East Area, while many of the watch-list and other potentially troublesome tanks are in the West Area. The questionable cross-site transfer capability would complicate any attempt to use the space in the East Area to empty a West Area tank. Accessible tank space is not only limited by the lack of reliable transfer capability but also by waste compatibility questions. Tank space may be limited by the need to avoid mixing wastes in certain incompatible classes or by the potential to increase the volume of undesirable waste species. Current waste compatibility judgments are made only on the basis of processing considerations and do not consider the potential for undesirable waste combinations. This problem is certainly illustrated by the situations in most of the watch-list tanks.

D.4.G. Existing Field Contamination

Cleanup of the contaminated areas within the tank farms was started in response to concerns that wind was causing contamination drift outside the tank farm boundaries. WHC decided that the apparent drifting was due to unique operations in specific tank areas. For example, an evaporation caused by sparging a tank with very hot air generated some aerosol, probably resulting in downwind contamination. In other cases, old cribs are in the area and growing weeds may have brought contamination to the surface. Other valid reasons for the cleanup are to prevent contamination of the tires of vehicles (a very rare problem), to decrease the radiation exposure of personnel, and to reduce the needs for protective clothing and HP surveillance. HP surveillance is important because the activity levels (up to 20 or 30 mrem/h) significantly restrict the on-the-job work time of tank-farm-maintenance and upgrade personnel.

The plans for cleanup have been documented (WHC-EP-0489). HPs surveyed the areas to be decontaminated and marked areas of contamination WHC manually removed twelve inches of soil to minimize the total amount removed (the soil must be stored as mixed waste at a cost of $67/ft^3$) and to minimize the spread of contamination. A layer of herbicide-impregnated geotextile was placed on the soil, shot-crete was sprayed on the textile, and the area was backfilled. The herbicide prevents weeds from penetrating into the still-contaminated soil. The procedure appears to be efficient and should [illegible]ce the reappearance of activity at the surface. Personnel exposures should be lower because remaining activity is shielded by the one foot of backfill.

The cleanup strategy for the tank-farm surfaces, although apparently sound, does not solve the problem permanently but rather alleviates fears of wind dispersal, eliminates contamination of vehicles, and reduces exposures of personnel. The measures planned should allow a longer work period for personnel in the tank farm areas and might allow relaxation of standards for personnel clothing and monitoring.

Nevertheless, the cleanup program was set at "low priority" has now been terminated, apparently because examination of survey data indicated that in general, migration of radioactivity has been very low. Other reasons for the cleanup apparently were not given significant weight. The subpanel recommends that this program be reinstated.

D.4.H. <u>Deficient Documentation</u>

The existing documentation of the support facilities and of tank farm instrumentation is deficient, and significant efforts are being made to update it. Presently, it is conceivable that proper emergency actions would rely on operator knowledge rather than on proper documentation of the facilities. Such a situation is unacceptable because of possible operator turnover, misunderstanding the total effect of changes in settings, and so on. The upgrading efforts for safety-related instrumentation and support facilities should continue to be high priority.

D.4.J. Continuing Degradation of Equipment

Evidence gathered in the review indicates that instruments and support equipment continue to deteriorate and that upgrades fail to keep up with new failures. As tanks and transfer lines continue to age, additional failures can be expected. Upgrades are completely slowly, partly because excessive emphasis is placed on documentation for safety grade systems that should be upgraded with less documentation. Delays in the upgrading result in the perpetuation of unsafe conditions and allow degradation to continue.

D.5. Problems Associated with Control of Facility Operations

D.5.A. Instrumentation Monitoring/Data Quality

To evaluate WHC's physical and operational control over the facility, the subpanel investigated the instrumentation systems that monitor waste conditions within and around the storage tanks. The information obtained is also useful in evaluating the status of Watch List tanks and the actual margin of safety maintained in their operation. We emphasized temperature measurements, waste-level monitoring instrumentation, tank-dome-stability measurements, and leak-detection systems, because these devices acquire data that are most critical for safety.

D.5.A.1. Temperature Measurements. This inquiry was originally conceived during the introductory presentations because of discrepancies in the number of thermocouples and level monitoring instruments that are active in the tank farm. The initial approach was to determine how many thermocouples are installed in the tanks, which proved to be more difficult than anticipated. Apparently, thermocouple readings are acquired manually and by three automated systems (two systems are in development). The automated systems include the following:

- *Surveillance Analysis Computer System (SACS) (proposed*
- *Tank Monitoring and System Control (TMACS) (Monitors Ferrocyanide Tanks)*
- *Computer Automated Surveillance System (CASS)*
- *Continuous Temperature Monitoring System (CTMS) (Monitors 101-SY)*
- *SCADA (under development)*

A different organization within WHC administers each of these instrumentation systems, and formal communication and information exchange channels did not appear to exist. As several of these organizations are located in Building 2750E, some informal interaction (not always productive) apparently takes place. Individuals in different groups would provide significantly different answers to the same question. The relationships among these systems is also unclear. Some overlap between TMACS, CTMS and CASS, and between SACS and CASS is apparent, but the subpanel could not obtain documentation (or clear explanations) of these relationships. Apparently, SCADA is intended to improve the interaction among systems, but exactly how it would do this is also unclear as there appears to be no standardization in hardware or software among the systems. Specific information received from WHC included the following:

- *A presentation to the Defense Nuclear Facilities Safety Board (DNFSB) in January, 1992 (Kasper, 1992), noted that 3116 tank-farms monitoring thermocouples were identified.*
- *The CASS system administrator stated that 2626 thermocouples were connected to CASS.*
- *The TMACS system is apparently connected to approximately 246 thermocouples (WHC-EP-0182-46).*
- *Staff responsible for compiling the manually recorded data could not provide the number of thermocouples monitored manually because a different number of readings apparently is received at each interval ("some thermocouple trees that are documented to have only 13 instruments generate 16 readings on some surveys," and other similar examples were provided).*
- *Manual data are also recorded on CASS.*

Determining how many thermocouples are functional at any given time was equally difficult. Specific information acquired included the following:

- *The presentation to the DNFSB stated that 33% of all thermocouples were not working and no thermocouples were operable in 42 of the 177 tanks.*
- *The CASS system administrator could receive data on only 111 of the 2626 thermocouples monitored on 4/28/92, including no instruments in the West Area (could not determine how many of the 25626 thermocouples were automated and how many were manual.)*
- *TMACS reported that for the instruments monitored by this system, 71 (29%) were "good," 87 (35%) were "acceptable," 51 (20%) were "marginal," and 37 (15%) had "failed" (per WHC-EP-0182-46).*
- *Staff responsible for compiling manually monitored data again could not provide an estimate of operable thermocouples because "at some intervals a thermocouple will be reported as failed and the next time it will be listed as good, or vice versa."*

The latter two observations also illustrate that there is nothing resembling an organized Quality Assurance/Quality Control (QA/QC) program to evaluate the data generated by the thermocouples or by other tank monitoring instruments. Presently, only two calibrated thermocouples are installed. Data verification consists of determining if a reading is within the valid range of the instrument (no formal procedure or recording system exists). Data validation is performed by checking against previous readings and nearby thermocouples to determine if the reading is as "expected." If an instrument reading varies by on the order of five to ten degrees from the previous reading and/or from the readings of "nearby" instruments, the data are considered to be invalid. Since most thermocouples are read no more often than on a weekly or monthly basis (or longer), and may be separated from other instruments by tens of feet, this system essentially precludes the identification of "hot spots" that may develop within a tank. Again, formal procedures or recording systems for this data validation do not exist. The actual data validation is performed by a technician with no technical background or training in evaluating temperature results. Responsibility for technical evaluation of the thermocouple data could not be established. Although the Shift Supervisor should review all data taken during his shift, he seldom has time. Individuals within the data acquisition groups spend some time reviewing the data but do not have the technical expertise to perform an evaluation. The impression given was that data were not reviewed until after a problem had surfaced through other means (or in response to an outside reviewer's question). WHC has not attempted to evaluate the precision or accuracy of the thermocouple measurements. The Red Team pursued this question with thermocouple calibration experts at the Hanford Standards Laboratory, an on-site organization that is independent of TWRS. After a cursory review, several members of the Standards Laboratory staff indicated that they would expect the accuracy of the thermocouples to range from $\pm 10^{o}F$ to $\pm 20^{o}F$, if the materials and the contact bond had not been damaged by up to 50 years' exposure to very hostile conditions. The Standards Laboratory staff, although nationally-recognized experts in the thermocouple field and possessing decades of Hanford expertise, were not consulted for input to nor for review of thermocouple upgrade projects.

D.5.A.2. Tank Dome Stability Measurements. Monitoring of the elevation of the domes of SST began in 1976 because of concerns that repeated changes in liquid elevations might affect dome stability (ARH-CD-427). Apparently, salt "stalactites" form on many of the risers, on the instrument tubes, and on other penetrations into the tanks. Lowering of the liquid level of the tank causes loss of buoyancy, and the dome supports the entire weight of these stalactites. Kaiser Engineers Hanford (KEH) performs measurements using standard land-surveying techniques between risers and other fixed features on the tank domes, as well as benchmarks established outside the tank farms. Measurement resolution is stated as 0.001 ft with an accuracy of ± 0.005 ft. Measurements are to be taken annually or biannually, depending on whether the tanks have dome-suspended airlift circulators. Failure to perform these measurements is a violation of an OSD and sometimes an OSR/SAR violation (WHC-SD-WM-TI-357, Rev. 1G). A review of the available manually-recorded and manually-maintained data indicated that Tank Farms 241-A and 241-SX are currently out of 357 Manual compliance. Data are evaluated using numeric criteria specified in the OSD and OSR/SAR documents. Apparently no consideration has been given to the season of the year, the air temperature in the tanks, the moisture content of the soil, or to any other environmental or operational factor that could effect dome elevation on the order of 0.001 ft. Moreover, the external benchmarks are not tied to an external reference; a Kaiser supervisor stated that they have never been checked in the ten years that he has been involved in the program. The original controlling document (ARH-CD-247) required such checks on an annual basis. During a cursory tour around three tank farms, WHC or KEH staff accompanying the subpanel member could not identify any external benchmarks locations.

D.5.A.3. Waste level Monitoring Instrumentation. Three types of instruments monitor waste levels: a radar instrument (only in Tank 241-SY-101), FIC gauges (an automatic conductivity probe), and manual tapes (manually-operated conductivity probe). Information received from WHC on waste-level monitoring included the following:

- *FIC gauges are installed in 109 tanks and the remaining 67 tanks are monitored by manual tapes only. FIC gauges in 21 tanks have manual tape backups;*
- *In the January 1992 report to the DNFSB (Kasper, 1992), 14 FIC gauges and 1 manual tape were reported as failed;*
- *In the January 1992 "Tank Farm Surveillance and Waste Status Report" (WHC-EP-0182-46), 20 FIC gauges were reported out of service, including 15 instruments that had been out of service over three months; and*
- *The Surveillance & Data Acquisition Daily Anomaly Report (sent to the Tank Farm Manager every day) for 4/23/92 shows 36 FIC gauges as failed, including 10 that monitor the levels in Watch List tanks and 33 that have been out of service over 3 months. (Figure D-1).*

These discrepancies could not be readily explained by the WHC staff.

The inability to take readings because of these failed instruments has resulted in two OSD nonconformances. As with the thermocouples, a QA/QC program does not exist for assessing the quality of the data generated by the function instruments. Apparently, salt crystals can form on the sensor end of the instruments, distorting the level reading. Except for Tank 101-SY, neither an engineer nor a supervisor regularly reviews the data (except when there is a problem or a reviewer's question).

D.5.A.4. Leak Detection Systems. Seven systems detect tank leaks:

- *Leak detection pits (DSTs only)*
- *Annulus leak detection (DST only)*
- *Annulus air monitors (DST only)*
- *Vertical Drywells (SSTs only)*
- *Liquid Observation Wells (LOWs) (57 SSTs only)*
- *Laterals (horizontal drywells) (beneath 15 SSTs only)*
- *Surface level measurements (both SSTs and DSTs)*

Surface level measurements involve the same instrumentation described above. Sixteen tanks in B, C, T, and U tank farms have surface level measurements as the only means of leak detection. The drywells and the LOWs are the principal leak-detection systems for the SSTs. WHC reports that all laterals are out of service and have not been used in approximately two years. Drywells are vertical steel casings set in the ground around the tanks. Radionuclides in the soil are observed through gamma and neutron geophysical probes. Drywells are used to monitor leaks in 133 SSTs, including 12 for which this is the only means of leak detection (except for level measurements). LOWs are similar fiberglass or Tefzel casings set within the tank. Gamma neutron and acoustical geophysical probes are used as monitors. LOWs are used to monitor 57 tanks. WHC reports that monitoring of all drywells and LOWs is proceeding according to the specifications of the "Waste Storage Tank Status and Leak Detection Criteria" (WHC-SD-WM-TI-357). Nevertheless, a GAO investigation is currently underway regarding the quality and applicability of the geophysical measurements. Although a copy of the GAO report was not available to the Red Team, preliminary findings indicate significant problems with these components of the leak-detection system. The Red Team also received conflicting information about the operational status of the annulus monitoring systems within the DSTs. An example of the problems with the systems is that the annulus exhaust monitoring system for Tank 241-SY-101 was out of service from November, 1991 until January, 1992, even though it is considered the primary leak detection system for this tank (RL-WHC-TANKFARM-1992-0003). The loss of the manual backup system on January 6, 1992 triggered a non conformance to the Limited Condition of Operation for OSR-T-152-00001 (SEC. 11.4). The report discovered that the work request to repair the primary system had been submitted as the wrong priority and then lost.

D.5.B. Repair of Instrumentation and Equipment

Repair of very old instrumentation and equipment is difficult because manufacturers usually do not support models that have been outmoded for decades, meaning that a repair may require special manufacture of a part. Another source of problems in the tank farms is not standardizing instrumentation, leading to difficulty in stocking sufficient spare parts. Because different manufacturers produce the same general type of instrument, training of repair personnel is difficult.

D.5.C. Maintaining Outdated Equipment

A general observation of the instrumentation program is that WHC attempts to "patch and fix" old equipment when it is well beyond its reasonable working life span. Two specific examples were identified in the thermocouple area, although this observation appears to apply to every facet of the monitoring program. The first example arose when WHC staff was asked why no thermocouple readings were being received from tanks in the 200 West Area. The responsible manager did not know, but the maintenance engineer informed him that the data logger that acquired all the readings and transmitted them to

CASS has been out of service for approximately two months. The data logger had been sent back to the original manufacturer for repair but had been returned because it was too old to fix. Rather than simply replacing it with a new, off-the-shelf data logger, WHC Maintenance was attempting an in-house repair. Similarly, the effort to rehabilitate the original thermocouples in 22 Ferrocyanide tanks took almost 2 years, at a cost of at least several hundred thousand dollars. WHC hailed this project as an example of resourceful engineering, but after such considerable expense of time and money, 40-year-old instruments producing data of indeterminate quality still monitor the tanks. These instrument systems will undoubtedly require frequent maintenance in the future. It is unclear whether this effort produces any real long-term savings of cost or time compared with the installation of new instruments.

The "old culture" of HTFO was that money was not available for true upgrades or new equipment and that "band-aid" solutions were the only way to operate. The repair of a compressor that was decades older than its expected life is a recent example of the continuation of this culture. The compressor failed again from another cause within weeks. When this specific repair was mentioned to the upgrade personnel, they reported that they had recommended against the repair. Part of the problem may be a lack of capital equipment funding; 11 compressors need replacement. At the current level of capital funding, between two and three years will be required to replace them. As a "quick fix" to this problem, a transportable compressor has been acquired to act as a stand-in for a compressor that is "down." This is a good temporary solution to a problem, but the replacement of old, unreliable equipment needs to be pursued more vigorously. Problems due to a lack of capital funding need to be corrected.

D.5.D. Shortage of Trained Personnel

The number of Persons-in-Charge (PICs) indicates a particular shortage of trained employees. One PIC indicated that he acts as the PIC for a group of approximately five craft people performing either maintenance or an upgrade. He says that he can be the PIC of up to ten simultaneous projects. Unexpected things occur that change the scope of the effort. If this happens when the PIC is not present, the craft people stop work and may even return to their home base. A regathering of the craft people is difficult and time consuming because the area is large. This number of assignments to a single PIC is excessive except for routine jobs. On the basis of jobs per PIC, the number of PICs must be lower than practicable. PICs could come from promotion of the brightest and most ambitious of the operators. Recruitment of PICs is difficult because the pressures are higher, whereas compensation may be lower because overtime pay is lost. It appears that providing overtime pay for the lower levels of PICs would encourage employees to fill the jobs.

A shortage of HPs is a major impediment to operations. The HPs do several jobs that could be performed in other ways. For example, an HP checks all personnel exiting from contaminated areas. At many sites other than

Hanford, personnel check themselves. Portal monitors facilitate the checking of personnel. We were told that the portal monitors at the Hanford sites do not operate; they should be repaired. HPs con. .ct area surveys "by hand," find a "hot" spot and mark it. Contractors use a radio-signal triangulation system in which an HP surveys the area and a computer on a grid automatically records "hot" spots. This method is more efficient and would remove the burden from internal HP technicians.

WHC recognized that the general training of the operators and craftsmen was inadequate. After finding that operators did not understand the basic functioning of their equipment, WHC established a basic training program to educate the operators. The personnel interviewed generally feel that the program is good. A possible concern is that few employees with experience are willing to be trainers because the pay is low. Other forms of training, including Emergency Preparedness, are given separately.

D.5.E. Rapid Turnover/Inexperience of Cognizant Engineers

The Cognizant Engineer (CE) has the primary responsibility for one or more projects in the tank farm, such as upgrading instrumentation. CEs are usually young engineers who are new in the area and take time to become familiar with the facilities and personnel. Many CEs do not remain in their assignments long enough to achieve familiarity for several reasons, including the following:

- *Priorities for projects shift frequently, with those that were below the "priority cut-off line" being emphasized by either DOE or WHC. When this happens, employees are removed from another project, causing it to falter. When the project begins again, a different CE may be assigned who will have to become familiar with the project. An approximate quote: "A good CE who is working on a project in the field eventually will know where all the valves, pipes, and electrical parts are and will understand the system completely. A new CE will be lost for a period of time." This problem is probably exacerbated by the current state of the facility Essential and Support drawings. It is not unusual to have two or more CEs on a project to before it is completed.*

- *The job description of a CE includes perhaps 27 items that are typical of things he is expected to do. This is obviously a high-pressure job and does not pay more than lateral jobs having much less stress. Thus, many CEs burn out and look for a transfer.*

D.5.F. Inadequate Document Infrastructure

The tank-farm drawing upgrade program has suffered a serious reduction in budget and personnel for 1992. This is not cost-effective because the plethora of obsolete, untrustworthy drawings is wasting much time and effort of crafts people performing maintenance. At present rates, it will take too long (about six years) to work off the backlog of Essential and Support drawings requiring upgrading. The field upgrade personnel appear to be very enthusiastic but need to pay more attention to checking the new drawings for accuracy.

The aim of the tank farm drawing upgrade program is to provide quality, field-verified drawings to support the upgrades of tank farm operations and equipment. Although field modifications appear to have been generally well documented through Engineering Change Notices (ECNs), the general lack of trustworthy engineering drawings for existing facilities usually requires an extensive walkdown before even simple maintenance work can be planned and executed. Time and effort are being wasted researching the ECNs in an attempt to establish the true configuration of field hardware and electrical systems.

The waste of time and effort in working with obsolete drawings does not appear to have been quantified. In addition to the general recognition that up-to-date drawings make good business sense, a thorough analysis of the extra costs incurred by working with out-of-date documents would very likely justify increased activity by the Field Verification Group. Nevertheless, budget and personnel have been cut by more than half since 1991.

Three hundred and seventy-six Essential and Support drawings were "verified," upgraded, and released by the Design Field Verification Service in FY 91 (period ending September 30, 1991); the service had 26 employees and a budget of $2.6 M.

In contrast, the 1992 budget is only $1.045 M for 10 employees. Eighty-five drawings (including twenty-three support drawings) were released in the six months preceding March 24, 1992. The 10 employees consist of a manager, three designers who perform the walkdowns, and four draftsmen who convert the original marked-up diagrams into computer assisted design (CAD) drawings. The quoted average cost for each upgraded drawing was $5 500. The group prefers doing the work "in-house." Experience with A-E organizations has not been favorable because the outside organizations are usually remote from the site. The quality of drawings from subcontractors has not generally been up to desirable standards, although it is difficult to see why such standards could not be set and maintained.

The Tank Farms Essential Drawing Plan (WHC-SD-WM-PC-002, Rev. 3), dated February 24, 1992, listed 961 Essential and Support drawings that need to be field-verified and upgraded. At the rate of 170 drawings released per year, six years will be required to work through the list. No doubt many of the drawings will need revisiting as of minor revisions, equipment identification numbers, and other items are added. This is slow progress.

Overall, the budget reduction for the Field Verification Service demonstrates a lack of WHC management commitment to getting as-built

Essential and Support drawings soon. Compared with the four draftsmen employed in the upgrade program, WHC employs about 120 draftsmen on the Hanford Reservation.

The plan for the Engineering Drawing Field Verification Program (WHC-SD-WM-WP-072), dated December 1991, appears to be sound. The plan deals with training of personnel, with procedures, and with quality reviews. Five percent of designated program drawings during the first half and five percent during the second half of the fiscal year will be randomly selected for departmental self-assessment by "responsible personnel."

According to the plan, the self-assessments are to be documented and are separate from the random reviews conducted by QA. During the Red Team investigation, a quick check of two complementary as-built Essential Drawings, the Engineering Flow Diagram (for Tanks 241-AN-101, 102, 103) and the Instrumentation Engineering Flow Diagram (for Tank 241-AN-102), revealed several important discrepancies in the instrumentation. The two drawings did not match.

CEs that have the responsibility for the facility featured in the as-built drawing sign off that they have reviewed and approved the drawing before release. However, Field Verification Service members had the opinion that the review and approval of some CEs did not carry much weight because the CEs were unfamiliar with their facilities.

Redrawing using the CAD format is not easy; the drawings certainly appear somewhat more professional, but no attempt was evident to make the drawings more user-friendly. For example, the upgraded Engineering Flow Diagram (H-2-70703, Rev 3) for the Waste Unloading Facility in Bldg. 204-AR remains as much a baffling complex of crossing lines as the original; more effort in layout would have greatly enhanced readability. Many of the components shown on the drawings have unique identifying numbers that are unique only to the facility and not to the site. The drawings reviewed lacked an equipment list or reference to such a list. The drawings reviewed do not indicate whether motor-operated valves are normally open (N.O.), or normally closed (N.C.); such an indication is a fairly standard feature for good instrumentation drawings. Nevertheless, the as-built drawings are by no means stand-alone documents; features that are difficult to field-verify because they are underground, inaccessible, or in areas of high-radiation fields are neither identified as "not field-verified" nor especially so marked. Reference must be made to the "red-line" mark-ups and to the ECNs to determine how much of an as-built Essential Drawing has really been field-checked.

Besides budget and personnel, other impediments to the upgrade program include lack of transportation to get out into the tank farms and inaccessibility of the facilities or their components. The three designers who form the field verification crew are allowed access to the farms only on Tuesdays and Thursdays. For example, on Wednesdays, HP technicians are usually receiving training and therefore are not available to assist the field crew. According to the field crew, Friday is clean-up day for the tank-farm operators. Presently, the upgrade program personnel can live with these restrictions to field access, but an expedited drawing-upgrade program would depend on better field access throughout the week.

D.5.G. Complex Management/Parallel Organizations.

One example of complexity is that three programs perform instrumentation upgrading: (1) Maintenance, which normally performs direct repair or replacement of an instrument; (2) Facilities Upgrading, which replaces instruments with improved types; and (3) Projects, which would receive special funding for major upgrades, such as installation of a new computer-controlled monitoring system. It is not clear how these organizations interact and how interfacing is accomplished. A less complex structure would make it easier to track accomplishments and expenditures.

Coordination among overlapping organizations is poor. For example, the operators do not necessarily know when instruments are taken out of service for calibration. Computer-generated cards that identify the specific PISCES components requiring calibration do not identify the instrumentation system(s) supported by the component. Thus, although operators are informed of when PISCES calibrations are being performed, they may not know which instrumentation systems have been taken out of service. This was a contributing cause to the water hammer incident at the 242-A Evaporator Facility. The operator did not realize that a sensor system that could have warned him about water hammer was not functional because of a PISCES calibration.

D.6. Retrieval Program

D.6.A. Underfunding

Retrieval of supernate and sludge from the waste tanks is required to support the pretreatment, the grout, and the vitrification operations. Retrieval is a joint program between WHC and PNL. PNL does engineering-scale testing of simulated sludge retrieval in a test facility. The program includes retrieval of core samples for characterization and laboratory and bench-scale studies, retrieval of 25-L batches for testing the Acid Dissolved Process, retrieval of 300-gal batches for pilot plant studies, and the provision of 3 000- to 12 000-gallon batches of slurry for Acid Dissolved Process waste-form qualification. The initial approaches to retrieval have been specified and are based partly on SRS experience. The current prime option for sludge removal is sluicing; a significant near-term decision is the acceptability of high-volume liquid retrieval technology to retrieve waste from sound SSTs. Questions to be resolved include the following: (1) methods for verifying the integrity of tanks before waste retrieval; (2) allowable tank leakage during retrieval; (3) requirement of external barriers to leakage; and (4) allowable waste heel that can be left in a tank.

All required activities are in a preliminary planning stage and will require a great deal of design and testing. A presentation covered the investigation of the integrity of the SSTs (by core-boring the concrete walls). We understand that one of the borings encountered radioactivity in the concrete, indicating some leakage through the inner wall. Most other issues received limited, if any, attention.

The retrieval activities must mesh with the pretreatment system. We understand that the location of the pretreatment pilot plant is uncertain, which can affect the retrieval activities at least to the extent of uncertainty about where to transport the waste and when such transfers will be needed.

The PNL portion of the program was cut off for three months last year and programs at PNL and WHC are to be interrupted again this year. It is difficult to see how this effort can meet its milestones with such disruptions. Even without continuity problems, the scope of the difficult questions facing the program and the limited budget will probably delay this program significantly. The plans include rapid ramp-ups of funding and personnel in the future; such ramp-ups are difficult and are not as productive as addressing the problems earlier with a smaller, continuing effort.

D.6.B. Minimal Technology Development

The scope of the subpanel's line of inquiry into retrieval was limited to two basic areas: emergency retrieval and retrieval to support bench-scale and pilot-plant testing. The subpanel received presentations from WHC on Emergency Preparedness and on Small Volume Retrieval Systems. Except for core sampling and a few special items, only minimal program activity seems to have supported overall retrieval needs. Funding for the program has ceased for the remainder of FY 92. Retrieval technology development will have to be put on the critical path later.

As formulated, the Emergency Preparedness planning for protection of employees and facilities does not include retrieval actions. Similarly, in the Ferrocyanide Stabilization Program, the Tank Farm Stabilization Plan for Emergency Response (WHC-SD-PRP-TI-001) identifies preplanned responses to postulated emergency events associated with core sampling at Tank 241-SY-101. However, this plan includes neither emergency retrieval actions nor recovery actions. We asked the WHC presenters about the existence of, or planning for, emergency retrieval equipment; their reply was negative, except for the possible use of existing sampling equipment. Clearly, WHC has neither the dedicated capability for emergency waste retrieval nor programs for expeditious retrieval or development of retrieval equipment.

The presentation on small volume retrieval systems included current and future planning. The current core sampling activity is apparently sufficient for the near term. A backlog of samples awaits analysis. Updated sampling and analysis plans will be issued in 1993. Watch List tanks will dominate the core-sampling program. A second core-sampling truck will be available by FY 93 to permit rotary-mode, hard core sampling of Watch List tanks.

Some activity is taking place in larger volume retrieval programs. The mixer-pump retrieval technology has been selected to support the ongoing NCAW-retrieval demonstration project. Process testing is planned for the SRS mixer-pump technology that has been adapted for use in Hanford DSTs. Since the recent demonstration of robotics systems, some additional activity has occurred in the large, articulated arm-development/demonstration program. WHC has identified a company in Iowa as a good source for a demonstration unit consisting of an articulated, hydraulically-operated, long arm with a supporting tower that could be used to demonstrate retrieval from an SST. This potential source may not be stable, however.

D.7. Waste Volume Projections

D.7.A. Models

The Process Engineering subpanel was impressed by the carefulness with which WHC makes waste volume projections and by the sophistication of the computer programming that makes the projections. However, the quality of the results are completely dependent on the reliability of the information and assumptions input to the model (garbage in—garbage out).

The long-range projection shows Hanford facility operations through FY 2015. It shows major tank-farm operations in yearly detail. The short-range projections cover 24 months and show tank-farm operations in monthly detail. The Operational Waste Volume Projection is based on short-term and long-term projections and on current facility assumptions about waste generation rates (Frater, 1991a; Stode, 1991).

The various scenarios to be used for volume projections appear to be based on assumptions having large uncertainties. These assumptions include starting dates for the Grout Facility operation, the 242-A Evaporator, the Liquid Effluent Retention Facility (LERF), the Liquid Effluent Treatment Facility (LETF), and SST stabilization. Many of the scenarios have been adjusted to fit under the tank-space limit provided by the availability in 1999 of four new DSTs. The decision to build four new DSTs came from DOE-HQ.

Waste generation input data information is obtained from the various facilities and projects by means of "call letters." In response, each waste generator provides a schedule of the amounts and type of waste that it expects to generate in the next year. The schedule is updated as necessary to meet changes in plans. The data are reviewed by the Tank Space Management Board, which has representatives from facilities and projects. Requests for tank space that are abnormal, or that cannot be easily accommodated or settled by negotiation within the board, are referred to a higher management level for agreement.

Because of delays in the evaporator restart schedule, in January, 1992, the Tank Space Management Board imposed newly reduced limits on the waste generated by each facility (Frater, 1992b). This action reflected a decision by WHC senior management to control tank space by eliminating or minimizing dilute waste sent to the DSTs. The new limits would produce a "12-month contingency" limit that could serve as a cushion for further evaporator restart delays. The reductions have been on target through March, 1992.

The accuracy of the projections depends on the accuracy of the waste generation estimates, on predictions of facility throughput and performance, and on starting dates. In the past, projected volumes of facility waste generation agreed well with actual volumes, except where a major change in the planned activity has occurred.

The last of the previous Annual Waste Volume Projections, issued in 1988, required formal approval and sign off by the Program Office and DOE-RL regarding the basic assumptions of facility schedules and waste generating and disposition rates. Although the Annual Waste Volume Projection for 1989 was completed, too many changes in assumptions rendered it useless. Although the assumptions for the 1990 projection were formally approved, continuing changes in the evaporator schedule caused it to be released only as an in-house document. Although formal annuals are not being issued, the Waste Volume Projection group produces long-range projections for various assumptions.

The major computations for waste volume projections are made on a PDP 1173 computer (Digital Equipment Corp.). The programming was done several years ago by an experienced programmer who later left the project. All the input data are currently developed on personal computer (PC) spreadsheets or manually. The waste-generation assumptions related to facility schedules, processing rates, and waste generation volumes and composition are entered into an elaborate PC spreadsheet that also contains the existing DST waste inventories. The spreadsheet contains many self-checking features that warn of incorrect assumptions, such as adding incompatible wastes to a tank. When the input computations are completed, the PC produces a hard copy of the results and a data input disk for the PDP 1173. The waste reduction scenarios related to evaporation, transfer between tanks, and grout campaigns are calculated separately and must be manually put into the PDP 1173. There are no independent checks of the results.

Producing a new long-range projection requires about five to seven working days: preparation of the waste generation spreadsheet requires four to five days and manual input on waste reduction takes one to two days. Automating the waste reduction inputs could substantially reduce the latter time. It is estimated that an experienced programmer could write such a program in about three months. The automation effort is being considered. To reduce or eliminate the elaborate spreadsheet and reduce the projection time to about two days would take a major programming effort that could last two years.

Two individuals (remaining from an original group of four) perform the waste volume projections. One person handles the long-term projections and the other handles the short-term projections. Both persons report to the Manager of Surveillance and Data Acquisition. Because the personnel ceiling was reduced, replacements have not been hired for two other employees who voluntarily left for other jobs.

At the request of the Deputy Project Manager, Tank Farm Project Office, DOE-RL, an employee of Stone and Webster (S&W) developed an independent waste-volume projection program (Berry, 1992). The S&W employee consulted with WHC employees during the project. S&W's mission was to provide a "fresh look" and a "global view" of waste-volume projections. Preparation of a PC spreadsheet that covers projections out to 2035 or later took three months. The spreadsheet could be used as a management tool for quickly reviewing the impact of changing major site assumptions or schedules, such as those for retrieval and pretreatment. In addition to the spreadsheet, S&W also produced a table of assumptions along with their sources and a multipage schedule of tank-farm projected operations that showed TPA milestones. The S&W spreadsheet can provide a handy "what if?" tool for strategic planning.

We believe that WHC fears that DOE will make major decisions (such as the number of new tanks to build) based on incomplete or incorrect results of the S&W spreadsheet. WHC and S&W agree that the S&W spreadsheet is not designed to accurately predict tank-farm operational requirements. WHC contends that the S&W spreadsheet does not accurately take into account important tank and waste details, such as Waste Volume Reduction Factors (WVRF), waste segregation, and the impact of partially-filled tanks that need to be isolated. However, these factors would make the S&W prediction less than actual needs, and the WHC projections are generally lower than those of S&W.

In our initial reviews, WHC appeared not only to have a low opinion of but also was reluctant to accept the S&W system. This attitude seemed to have completely disappeared by the end of our review, however, with the likelihood that WHC would adopt the S&W System.

According to WHC, their waste-volume-projection system has the following important advantages over that of S&W:

- *actual tank inventory and usage provides important information for tank transfers, for tank retrieval schedules, for solids build-up, for criticality, for clean-out scheduling, and serves as an historical database;*
- *accurately depicts the characterization and preparation time needed for each waste stream in DSTs for evaporation, grouting and vitrification;*
- *determines the amount of waste reduction from the WVRFs;*
- *accounts for operational tanks and their specific designed use.*

The WHC projection is clearly much more comprehensive than that of S&W. The WHC output has an excellent graphic presentation that the viewer can easily interpret. The graph presents the number of DSTs required for each FY from 1981 to 2015. The S&W spreadsheet output is just that, a spreadsheet. One row of the spreadsheet gives the total waste (kilogallons) in all the DSTs for each FY from 1991 to 2035. Many other rows list the additions and subtractions of waste in kilogallons related to various processes and facilities. A row near the bottom gives the number of new DSTs required for each year. The number of tanks is based on total waste volume. The S&W projection does not consider the restrictions on adding incompatible waste to partially filled tanks. In the base case shown, 44 new tanks are required in the year 2008. The base case assumes retrieval and processing all SSTs starting in 2003.

On the basis of its review, the subpanel has concluded that the WHC waste-volume projections appear to be technically sound. However, some nontechnical considerations, including the impression that DOE-EM will not support the building of additional tanks, appear to inordinately shape the projections, resulting in overoptimistic schedules.

To reduce the turnaround time, the subpanel suggests that WHC pursue revising the projection program, at least to the extent of automation and replacement of the manual entry of waste-reduction data.

WHC should adopt the S&W spreadsheet because it appears to offer several advantages, particularly in turn-around time. With appropriate warning on interpreting results, it could serve to indicate trends resulting from major decisions relating to schedule and/or facility modifications in a short time without burdening the WHC projection process. The output could easily be converted to graphical form. Finally, the S&W system serves as an independent check of the WHC system.

Retaining the projection programs on PDP 1173 appears to be a proper choice. Although Digital Equipment Corp. no longer supports the PDP 1173, WHC has at least three, and possibly several more, new PDP 1173s in storage. Experienced programmers are available.

D.7.B. Overoptimistic Projections

More realistic expectations for delays in facilities and for new waste streams need to be factored into the waste-volume projections. The waste-volume projections are made using good projection methods, but input scenarios are unrealistic. The projections assume that the Grout Facility and the 242-A Evaporator will start up on schedule and will not meet operational difficulties. The Grout Facility is soon to have a core boring of the first casting. Any nonconformance found will result in a delay. The waste-volume projections do not completely take into account the eventual generation of large amounts of waste by decommissioning and decontamination (D&D) of facilities, such as PUREX. A major load on the system could result from environmental restoration activities. Resolution of the tank-safety issues may generate additional waste volumes.

D.8. SST Stabilization and Isolation

The purpose of stabilization and isolation of an SST is to remove most of the drainable water from the tanks and then seal any potential intrusion points to prevent reintroduction of water. Prevention of future tank leaks and waste migration into the soil is the rationale for this procedure. The logic of this process appears to be validated because it has been three years since the last recognition of a new leak from an SST. However, several possible adverse impacts of stabilization and isolation are as follows:

- *Absence of liquid may promote increasing waste temperature and/or undesirable chemical reactions, including accelerating corrosion rates of the tank structure.*
- *Absence of liquid may impede future waste retrieval actions.*
- *Liquid must be transferred to a DST, occupying already scarce tank space.*
- *Isolation activities have damaged tank monitoring equipment and data transfer lines.*
- *Additional stress may be placed on a transfer system that is in generally poor condition.*
- *Removal of liquid may stress tank domes by removing buoyancy that supported heavy salt "stalactites" formed around risers and other tank protrusions.*

The basic problem appears to be that no quantitative risk assessment has been performed on the impacts of either a tank leak or the items listed above, preventing a clear value-engineering analysis. However, the reason for this situation appears to reach back to even more fundamental problems in the tank farm identified elsewhere in this report, such as:

- *lack of definitive waste characterization;*
- *lack of understanding of the chemical and physical processes within the tanks;*
- *deterioration of facility infrastructure; and*
- *inadequate DST space.*

The arguments for and against stabilization and isolation appear to be far more complex than previously recognized by WHC and further analysis appears to be in order. Clear resolution of the issue would have required a level of effort beyond that available to the Process Engineering subpanel during this review.

D.9. Safety Documentation for Tank Farms

Approximately 17 obsolete SARs, some of them very old, are to be revised and combined into three or four by 1996. The SARs will provide a sound technical basis for tank farm OSRs, Safety Equipment Lists, and operating and emergency procedures. Authoritative SARs will need the support of "as-built" Essential and Support drawings for tank farm facilities. It is therefore imperative that the drawing upgrade program be expedited so that the SARs will rest on a sound technical base. Implementation of OSRs will require that field monitoring equipment and control systems function effectively, and that the composition of the waste in the tanks be known with some precision.

The purposes of the Tank Farm Safety Documentation programs are to establish a defendable Interim Safety Envelope for normal and routing operations, and to establish a current safety analysis that meets emerging requirements and sets a working Operating Safety Envelope.

According to a presentation by the manager of Tank Farm Safety Analysis Documentation to the Process Engineering subpanel on April 15, 1992, an interim OSR for DSTs was in the process of being developed, with transmittal to DOE-RL planned for June 30, 1992. Implementation will begin as soon as DOE-RL gives approval to the OSR. DOE-HQ comments will be incorporated and the DST-OSR revised accordingly.

The OSRs for SSTs and the Aging Waste Facility (AWF) had not been started at the time of the presentation, but lists of OSR topics are to be generated by September 30, 1992. Interim OSRs are to be drafted and reviewed in FY 93.

A Safety Equipment List for DSTs is to be prepared in CY 92, in conjunction with the DST Interim OSR. These will be incorporated into the SAR during 1993 and 1994.

A multiphase Safety Equipment List development strategy was presented; phase three of the strategy depends on Probabilistic Safety Assessment of systems, equipment, components and parts.

D.10. Tank Farm Procedures

D.10.A. Importance of Procedural System

To ensure the operation of existing or future processes in a safe and technically adequate manner, a well-administered and clearly understood procedural control system is essential. Important components of such a system were defined and compared to WHC's status and plans.

D.10.B. System Components

A strong procedural system should include the following:

- *management documentation that defines the administrative systems for producing procedures, including approval and change requirements;*
- *clear definition of management expectations for use of procedures;*
- *a well-defined system for deviating from procedures–it is especially important that shifts understand requirements;*
- *approval of original procedures and any revisions or deviations by a knowledgeable technical organization independent of the operating group;*
- *auditing systems to ensure that procedures are current, adequate, and followed; and*
- *administrative procedures to ensure that only current versions of procedures are available to the operating group.*

D.10.C. WHC Procedural System

WHC has approximately 450 active procedures in the tank farms, plus several hundred that are inactive or void. Most active procedures do not conform to the requirements of DOE Order 5480.19, "Conduct of Operations (COO) Requirements for DOE Facilities." In December, 1991, WHC strengthened its organization to devote much more effort to procedural upgrades.

The organization has a group devoted to tank-farm procedures under a manager who reports to the "Operations Support and Upgrades" manager. The procedures group has six permanent WHC procedure writers plus six writers (of eight planned) on contract, each of the latter having a minimum of twelve years of procedure writing experience. The systems engineering group reporting to the "Engineering and Projects" manager was formerly responsible for procedures. This group had only three people assigned to procedures. The level of effort has thus increased from three to twelve or fourteen, plus a manager. The current program includes essentially all of the desirable system components listed above.

Management policies and expectations are defined in the WHC document hierarchy, although all the revisions to recognize the new TWRS organization are not yet in place (WHC-CM-1-1, Section MP 1.6; WHC-CM-1-1, Section MP 6.5; WHC-CM-1-2, Section CH 16.0; WHC-CM-1-3, Section MRP 4.16; WHC-CM-1-3, Section MRP 5.43; WHC-CM-5-5, Vol. 1, GA-3.1; WHC-CM-5-5, Vol. 1, GA-3.2;

WHC-CM-5-5, Vol. 1, GA-3.9; WHC-CM-5-5, Vol. 1, GA-3.10; WHC-CM-5-5, Vol. 1, GA-3.11).

An internal surveillance program requirement is specified in WHC-CM-5-5, Vol. 1, GA-2.7, August 2, 1988, but we were unable to determine if it had been implemented with respect to procedure compliance. The QA groups perform surveillance activities (WHC-CM-4-2) that do not appear to meet the intent of GA-2.7.

Other initiatives to accomplish the objectives of procedural upgrading are in place. A detailed procedure preparation guide was issued in November, 1991 (WHC-IP-0731) providing detailed instructions and examples, and incorporates the requirements of DOE Order 5480.19. A field verification and validation guide in draft form, the guide provides a thorough field review by engineers and operators to be sure a procedure will work in the field, and that operators will understand it.

Shift coaches (contact personnel familiar with implementation of COO requirements) are assigned to each shift. Shift coaches not only help shifts to understand and to implement procedures and but also contribute to the procedure program by developing procedures to meet parts of the DOE Order. Specific examples are the development of "Round Sheets" (the successor to data sheets in several procedures) and shift turnover procedures.

D.10.D. Schedule

Alarm procedures and plant operating procedures are planned for upgrading, tank farm by tank farm, beginning with A and AN farms. The whole job is expected to take about three years, but no documented schedule is available. New requirements continue to arise; a major effort is underway to revise all procedures associated with the operational readiness review for evaporator start up to meet all current requirements.

D.11. Occurrence Reporting and Processing of Operations Information

The purpose of the Occurrence Reporting Program (ORP) is to ensure that both DOE and WHC line management, including the Office of the Secretary, are kept fully and currently informed of all events that could (1) affect the health and safety of the public; (2) have a serious impact the intended purpose of DOE facilities; (3) have a noticeable adverse effect on the environment; or (4) endanger the health and safety of workers.

DOE policy also requires that there be a system for determining appropriate corrective action and for ensuring that such action is effectively taken. In other words, determine why the event occurred and prevent it from happening again. Prevention of repetition involves solving the problem, whether the problem involves procedures, training, hardware repair, or devising a novel technical solution. "Lessons learned" is an important part of the ORP.

Events or conditions at HTFO are evaluated soon after they are discovered and then sorted into three categories: Off-Normal, Unusual Occurrences, and Emergency. Between September 4, 1990, and April 22, 1992, 171 events or conditions were reported in the tank farms, of which 136 were determined to be Off-Normal, 35 were UOs, and none were Emergencies.

The review by the Process Engineering subpanel found that (1) corrective actions were determined and tracked, (2) the corrective actions were being reviewed by management for adequacy, and (3) Tank Farm ORP was receiving independent oversight. Corrective actions in the UO incidents are being taken and usually tracked effectively to an appropriate solution.

Out of the 171 events or conditions, 6 were actual or potential violations of the Lock and Tag Procedure that were classed as UO, demonstrating that such a classification is no guarantee against repetitions of the violation. Nine incidents involved spills of diesel fuel or gasoline and two involved spills of antifreeze; all were classified as Off-Normal. Twenty-three Off-Normal incidents involved radioactive contamination of personnel, clothing, or equipment in supposedly clean areas.

Some UOs were purported to be "discoveries" of serious conditions but were more likely to be conditions that had been known and tolerated for some time until management or DOE-RL decided to raise the issue. For example, RL-WHC-TANKFARM-1992-0007 reports that "Tank Farm Internal Assessments Uncovered Deficiencies in Solid Waste Compliance Issues Due to a Lack of Programmatic Direction." "Missed TPA Milestone," a "Missed Programmatic Milestone for 242-A Evaporator Re-Start," and an Off-Normal: "Dome Deflection Survey Two-year Requirement Exceeded" are examples of other UOs. While these are important, it is stretching the definitions of events or conditions requiring the ORP (DOE Order 5000.3B, Draft).

Other trivial events (for which the ORP appears to be an overblown, inappropriate response) included the Off-Normal "Contaminated Rabbit Feces in Uncontrolled Area," and "Inadequate Review of Data Sheet Log Entries."

Two individuals presently handle Occurrence Reporting for the tank farms; four reporters handled it a year ago. However, only one of the current ORP reporters had the password to the ORP computerized database at the time of the Red Team investigation in April and he was off-site attending an ORP Update Seminar. Both reporters appeared to be competently handling the work load at present.

Selecting only those events or conditions that are worthy of inclusion in the ORP and eliminating minor incidents from this cumbersome process will permit a more appropriate level of effort to be applied in devising technical and managerial solutions to the difficult problems confronting WHC in the tank farms.

D.12. Summary of Interviews

As part of the Process Engineering Subpanel evaluation of HTFO, ten WHC personnel were each interviewed by one or two team members on April 14-15, 1992. The purpose of the interview was to gain insight into perceived tank-farm conditions from a cross section of knowledgeable people. Those interviewed were three operators or former operators, two engineers, and five managers at several levels. The information from the interviews was used in developing the topics for further investigation during the last week of site visits.

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APPENDIX E

FACILITIES ENGINEERING SUBPANEL ASSESSMENT

E.1. <u>Review Process.</u>

The objectives of the Facility Engineering Subpanel review were to examine (1) the physical and functional condition of existing equipment, (2) the status of the maintenance program, and (3) the organization, planning, and scheduling of new projects in the Hanford Tank Farms. Another objective of the review was to identify strengths and weaknesses in the existing facility and proposed facility modifications. The scope of the review included the waste tanks, related waste-transfer piping, equipment, instrumentation, and the evaporator system. Issues that were addressed by the subpanel include but are not limited to the following:

- *Existing equipment*
- *Maintenance*
- *New projects*
- *Facility interfacing issues*

The focus of the present assessment is to evaluate the schedule, cost and efficacy of retrieving, processing and stabilizing radioactive, hazardous waste contained in the Hanford waste farm.

E.2. <u>Summary of Findings</u>

The Facility Engineering Subpanel investigation included the existing 200 Area East and West tank farms. The subpanel found that existing tank-farm facilities are in poor condition and are deteriorating at an accelerating rate. Procedures that provide for upkeep of the facilities are not being implemented because of sub-optimal prioritizatio. and lack of coordination among plant groups. Continued loss of operating equipment will inevitably affect safe operation of the facility. Although adequate personnel are available, failure to assign priorities, to expedite paperwork, and to coordinate support from other groups has prevented proper maintenance of facilities. Other factors hindering replacement of failed equipment include the questionable specification of safety class replacement components requiring long procurement lead times and severely limited access and work-time restrictions in the waste-tank areas.

Maintenance and operations do not appear to be coordinated as demonstrated by the difficulty the ITR team had in establishing the nature of a maintenance tag on the exhaust fan of Tank 101-SY. This weakness in Conduct of Operations for the waste tank with the most serious safety problem is of concern.

The waste-farm evaporator upgrade is complete and the LERF is nearing completion. Four new waste tanks with ancillary equipment and the Cross-Site Transfer Lines are two new major projects that were identified. These projects are currently in the preconceptual design stage and have not yet been funded. The recent decision not to fund the acceleration of new tanks from 1999 to 1996 will increase the risk of exceeding existing available tank space. Future new projects include a pretreatment facility and an liquid effluent treatment facility. Process definition for these facilities is not complete.

E.3. Problems Identified in HTFO Facilities

The facilities in the waste tank farms are situated in both the East and West sides of the 200 Area. Interfacing facilities include the B-Plant, PUREX, the Plutonium Finishing Plant (PFP), the LERF and other facilities that supply waste to the tank farm and receive wastes from the tank farm. New projects include new tanks and cross-site transfer line to be located in existing tank-farm areas. The findings of the Facilities Subpanel, based on document review and staff interview, identified the following problems:

- *Existing equipment is poorly maintained and largely inoperable.*
- *Planning for new projects is inadequate.*
- *There are large uncertainties in the projections for future wastes to be sent to the tank farms.*
- *Planning and execution of work in existing facilities and new projects is not coordinated.*
- *Maintenance and operations resources are not properly focused.*
- *Radiological contamination and inadequate control of vapor emitted from tanks restricts working conditions in some tank farms.*

E.3.A. Issues Associated with Existing Equipment

E.3.A.1. Single-Shell Tanks. Of 149 SSTs, none are in service, 66 are assumed to be leaking, 105 have been interim-stabilized, and 98 are interim-isolated (WHC-EP-0182-42). Insufficient monitoring wells are available to positively identify individual leaking tanks. Particulate filters have been added to 128 of the SSTs (WHC-EP-0440). Several incidents have been reported involving the release of noxious vapors from tank vents. Because absence of adequate control of vapor release has restricted entry into tank farms, vapor monitoring must be performed before work can be started in the areas.

E.3.A.2. Double-Shell Tanks. DSTs are not only the newest and but also the only active tanks receiving waste. Currently there is space to receive about one million gallons of waste. At the present rates of waste transfer, this space will be exhausted in five months. It is planned that on December 30, 1992, Evaporator 242-A will be running and transferring condensate to the LERF, which also should be ready on December 30, 1992. This can then reduce in-tank volumes until FY 95, when the TPA dictates the end of LERF input. The LETF will have to be on line by this time if the evaporator operation is to continue.

E.3.A.3. Transfer Lines. Of six existing inter-site transfer lines, only one is definitely operable, but a second could be tested and possibly used. Transfers between East and West Areas are conducted using steam jets to ensure suspension of solids, but this adds the steam condensate to the original waste volume.

E.3.A.4. Evaporator (242-A). The evaporator has been rebuilt and is now more than 95% complete. Issues remaining are operator training and permits; both are planned for completion in December, 1992. It is noteworthy that few parts of the evaporator have redundant or back-up components, and that the maximum use of the evaporator will require nearly full-time availability to process the 13.5 million-gallon capacity of the LERF. A failure in any part of this set of process equipment will cause holding of more waste in existing DSTs, leaving zero space available sooner than is currently projected.

E.3.A.5. Instrumentation. Throughout the tank farms, instrumentation is generally in poor condition. A substantial portion of the approximately 3 000 out-of-service items involves instrumentation, from thermocouples to gauges to data-acquisition systems. A positive consideration is that the status of some tanks (interim stabilized, partial interim isolated, or interim isolated) may not require operation of most (or even any) of the existing instrumentation. This cannot be completely determined until characterization (gas, liquid, and solid), and appropriate SARs are completed. The planned farm-by-farm upgrade includes instrumentation and the capability for remote monitoring through CASS, TMACS, or other systems. An instrumentation upgrade is planned for the East Area (W-199, @ $30 million), with the engineering study scheduled to begin in FY 93. Construction is scheduled to begin in FY 96. The West Area will follow with studies starting in FY 94 and construction in FY 97 (WHC Milestones, 1/6/92 and 1/2/92).

E.3.A.6. Data-Acquisition Systems. The subpanel toured the CASS system. CASS collects data from all DSTs and is programmed to give alarms if out-of-tolerance reports are received. The system seemed to provide good data and reports on those tanks where the instrumentation was in working order. Of the 177 tanks, only 28 are double shell, however, and not all of those have working sensors. The datalogger that transmits all of the thermocouple data from the 200 West area was out of service. The risk implied cannot be accurately assessed without characterization of the tank contents and new SARs. A similar system, TMACS, is planned to collect temperature and level (liquid) data in the SSTs by early FY 93.

E.3.A.7. Redundant Systems. Most systems and components in the tank farms do not have a reliable back-up in place. Exceptions occur in the boiler feedwater systems for the power plants, as has been the norm in boiler plant design for nearly 75 years. The site does have some emergency diesel power units. For example, a 200 kW unit provides backup to the 242-A evaporator. Also, a loss of power will automatically open drains in the evaporator to ensure that overpressure or overfill or both will not occur (Interview(s), 4/27/92). On a larger scale, no redundancy is available for most (if not all) of the general systems: cross-site transfer, intrafarm routings (through jumpers), additional evaporators, transfers between farms, transfers from facilities to the DSTs, and transfer to the LERF.

E.3.A.8. Buildings. The age of tank-farm buildings ranges from over 45 years to less than 2 years (due to remodeling). Most office space is overcrowded, with some functions being carried out in facilities unsuited for their conscripted use. The 242-S evaporator is a good example; it is used to house West Farm operators since its standby status requires that power, heat and cooling be maintained. The overcrowding may be relieved in the future by reorganization, with personnel being shifted to other locations. Additional building space will be provided by a new project denoted Tank Farms Radiological Support Facilities (W-188, $8 million), with functional design criteria scheduled to finish in March, 1992. (The schedule provided was current as of 1/6/92.) Other new buildings are planned as a part of the Multi-function Waste Tank Facility (W-236, $400 million).

E.3.A.9. Utilities (Exterior to the Tank Farms). The 200 Area utility system includes potable and fire-protection water (common system), sanitary sewers, steam, electrical power distribution, roads, and rail systems. These systems are in satisfactory-to-good condition. The rail system is better than it was, and the electrical distribution system is also in substantially better condition since a recent upgrade. This upgrade established distribution voltage at 13.8 kV, with feeds at 480 V, compatible with modern electrical equipment. All tanks requiring duplex feeds now have them. Responsibility for these systems stops at the "weatherhead," with apparent good coordination between the utilities groups and tank-farm personnel.

The single major utility problem is steam generating capability. 200 East and 200 West have only one plant each. The plants are connected with a cross-site steam line sized to carry 205 000 pounds per hour, sufficient for the current operating scenario of approximately 200 000 pounds per hour. At least 8 000 pounds per hour is required to keep the cross-site pipe up to temperature, if it is used. The East plant has three coal-fired Erie City boilers and two oil-fired Riley boilers. Each boiler is rated at 65 000 pounds per hour (down from the original rating of 85 000 pounds) and operates at 225 psi. The West plant has five Erie City units and a 'package' oil-fired unit, with the same ratings. All boilers have some plugged tubes as well as other marginal equipment.

The East plant, considered to be the main source of steam today, has met current needs but with little or no margin, and at one time in the winter of 1992, all boilers were down. At the time of our review, one unit in the East area was down and scheduled for rehabilitation in June, 1992. Interim upgrades will be required for induced-draft and forced-draft fans, for boiler feedwater and make-up systems, as well as for ash and coal handling systems. A plant upgrade project is planned (LO-17, $33 million), but it is not identified in the milestone schedule provided by others (Interview(s), 4/28/92).

E.3.A.10. Mobile Equipment and Transportation. Tank-farm mobile equipment includes rail cars (tank and flat) and engines; the entire fleet of normal facility vehicles; heavy equipment (such as cranes, bulldozers, scrapers, and loaders); and special vehicles (such as the new core sampling trucks and five dry-well monitoring vans). The equipment is maintained by one central shop, and all on-site transportation is managed and controlled from the same facility. No complaints were noted on the availability and serviceability of the mobile equipment (Interview(s), 4/28/92).

E.3.A.11. Emergency Equipment. The subpanel did not examine emergency equipment *per se*. However, we observed several tank farms that reported using portable lighting and ventilating equipment. The depth of reserves for these and other types of equipment was not assessed.

E.3.A.12. Pumps. Sixty-three transfer/mixing pumps are now in place, with 123 locations where pumps can be used. These pumps, usually with a 40 to 50 foot shaft lubricated by the waste material, have an average lifetime of one-million gallons or about 200 hours of evaporator operation (at ±100 gpm per cut). The waste fluid (specific gravity 1 to 1.7, viscosity 1 to 30 centipoise) is highly abrasive. Seventeen of these pumps have been in use since November 1, 1991; five with and twelve without spares. There is a potential projected need for 48 pumps by the end of FY 93 (17 months); 43 are in place and 5 new pumps are required. Delivery of the last 6 pumps ordered began 12 months after order and was completed at the rate of 1 per month. The number of pumps required may vary according to operations plans. This information and the design basis for the required pumps is needed to establish the specifications and the number of pumps required and the required delivery timing (Interview(s), 4/27/92; Mechanical Equipment Status presentation, 4/22/92).

E.3.A.13. Compressors. Compressors are used for process applications and for instrument air. Thirty-seven systems are located in twenty-six facilities, ranging in age from four months to over fifty-five years (circa 1937). Configurations include 19% lubricated piston/rotary screw and 81% nonlubricated piston (suitable for instrument air). Cooling systems include 30% once-through water cooled (with the cooling water routed to the waste stream), 10% closed-loop water cooled, and 60% air cooled. None of the compressors have functional dryers and 14 (39%) are down. Nine of the failed units are being replaced, and six working units are also scheduled for replacement. In addition, nine units are being repaired. The average downtime for repair or replacement or both is now 10.4 months. Downtime is exacerbated by problems that the JCS is intended to address, such as poor drawings, lack of a sound design basis, and safety classification. Also, the deteriorating air piping system is often leaking so badly that an instrument air system requires 15 times the air that is needed. Historically, degradation accelerates: on June 13, 1991, 9 compressors were down; on April 21, 1992, 14 were down (of which 7 were already down on June 13, 1991) (Mechanical Equipment Status presentation, 4/22/92).

E.3.A.14. Ventilation (Active systems, not including passive filtration). The purposes of tank ventilation are primary confinement and cooling: 58 fans are located in 23 facilities: 7 units for SSTs, 11 units for DST primary, and 8 annulus units. The age of the ventilation systems spans from 8 to 48 years. The typical configuration is: an isolation valve; a moisture separator; a heater, an HEPA filter bank, a centrifugal fan; monitoring equipment (nuclear); and a stack. At this date, 12 units (21%) are down: 5 are Safety Class 2; 7 are Safety Class 'TBD' (it is likely that all are Safety Class 2); 8 are in the JCS system, and 4 are at the Work Control Center. The average downtime for ventilation equipment is now five months. Historically things are getting worse: on June 13, 1991, 7 units were down; on April 21, 1992 (10 months later) 12 units were down and three were the same (Interview(s), 4/27/92; Mechanical Equipment Status presentation, 4/22/92).

E.3.B. Issues Associated with Maintenance

E.3.B.1. Job Control System. Most users consider the JCS to be a good system, especially when applied to new facilities that are in good condition and have good documentation. However, the rigid application of the JCS to degraded tank-farm facilities has resulted in little work being accomplished; over 2 400 ,ob packages are backlogged. The system requires current equipment documentation that is not available and therefore must be generated. The JCS also specifies that safety class components be used, without regard to the design of the original system.

E.3.B.2. Preventive Maintenance. Tank-farm personnel felt that more attention and priority were given to the preventive maintenance program than to the corrective maintenance program. They indicated that the preventive maintenance program did not have a proven basis, and that often preventive maintenance was carried out on equipment that was out of service.

E.3.B.3. Calibration. We observed situations in which inoperable instruments were being calibrated to satisfy OSRs. We were told that WHC had requested a change in the OSR so that these calibrations would not be required, but DOE-RL had not approved the change. The presence of yellow maintenance tags indicated that about half of the instruments observed by the subpanel in the tank farms needed calibration (On-Site Inspection, 4/28/92).

E.3.B.4. Upg Two of the East tank farms were in the process of being upgraded. More s were contemplated but not scheduled. The T, TX, TY farms have hac ontamination removed, and have been regraveled to allow work in t. ... s without special clothing and fresh air (Tank Farm Upgrades presentation, 4/27/92).

E.3.B.5. Personnel Availability. We observed several insta..ces where adequate personnel were available, but failure to assign priorities, to expedite paperwork, and to coordinate support from other groups prevented proper maintenance of facilities.

E.3.B.6. Working Conditions. As noted elsewhere, conditions in the tank farms have deteriorated. Many areas of surface contamination have been identified and roped off. We were told that none of the self-monitoring equipment at the farms is in working order. Hanford, a high desert environment with a very wide range of temperature and humidity, is often subjected to very high winds and dust.

Radiological contamination and potential vapor hazards require the use of protective clothing and fresh air and the continuous presence of HP technicians and industrial hygiene personnel. The time required to assemble support personnel, as well as work rules that restrict work in fresh air to two hours without a break, reduce productive personnel to 40% or less. For example, breaking containment for core sampling required nine to twelve people from five different organizations.

E.3.B.7. Coordination of Maintenance with Operations. The subpanel is concerned that operations and maintenance functions are not being coordinated in the important area of tank safety. During an inspection of the tank farm a member of the subpanel noticed a yellow maintenance tag on the exhaust fan for tank 101-SY, the tank that produces periodic surges of flammable gas. The operator in the tank farm thought it was for a "bad bearing" but did not know the status. The subpanel member took a picture of the fan showing the attached tag. The DOE-EM representative requested a status report on this maintenance item the same evening of the observation. The WHC report later that evening was that there was "no tag and no problems" with the 101-SY exhaust fan. Further requests for information and an inspection by the DOE-RL site representative finally resolved the issue over a week later. This is evidence of poor Conduct of Operations for one of the most important safety questions in the DOE complex.

E3.C. Issues Associated with New Projects

E3.C.1. New Tanks. The current new tank project comprises two tanks for waste processing and two tanks for waste storage. It is the consensus of the subpanel that additional waste storage capability will be required and should be included in current project plans to be made available by 1997 (W-236, Project 93-D-183). The subpanel questions the requirements for American Society of Mechanical Engineers Section III, Class 1 construction (as though the tanks are nuclear reactors), for a stainless steel primary liner for the two waste storage tanks, and for a stainless steel secondary liner on the two process tanks. Eliminating these requirements would reduce cost and construction time dramatically.

E3.C.2. Issues Associated with Cross-Site Transfer Line. The Cross-Site Transfer Line is now planned as two, three-inch stainless steel jacketed lines for transfer of waste between the East and West Areas. Routing of the lines to minimize excavation in contaminated areas appears to be well considered. Consideration should be given to providing additional lines in view of the failure of existing inter-area lines.

E3.C.3. Issues Associated with the Liquid Effluent Treatment Facility. The LETF is required for ultimate disposal of water from the waste storage tanks. However, plans for this facility are woefully incomplete and funding and designs do not appear to support the op mistic date of completion and release of evaporator condensate from the LERF after two years' storage as required by the TPA.

The subpanel was aware that there were other projects, including upgrades of ventilation, electrical, and instrumentation. Currently planned projects total approximately $500 million, including the new tanks, transfer lines, and other work. Future projects total approximately $370 million.

E3.D. Issues Associated with Interface Facilities.

The subpanel considered both upstream and downstream facilities that contribute and have the potential to contribute waste and that will receive waste from the existing tank-farm facilities.

E3.D.1 Upstream Facilities. Upstream facilities contributing and having the potential to contribute waste include the following:

- *B Plant*
- *PUREX Plant*
- *Cesium and strontium capsules*
- *S Plant*
- *T Plant*
- *PFP Facility*

- *242-T Evaporator & 242-S Evaporator*
- *100 Area reactors*
- *300 Area*
- *Fast Flux Test Facility (FFTF)*
- *2300 55-gal barrels of waste*
- *D&D operations for above facilities*
- *Other unknown contributors*

The volumes and types of wastes from these upstream facilities may change as the Hanford Site moves into D & D.

E.3.D.2. Downstream Facilities. Downstream facilities include:

- *Multi-Function Waste Tank Facility (four new tanks)*
- *Evaporator - equipment upgrade 99% complete; awaiting regulatory approval and operator training before operation*
- *LERF - nearing completion; usable only through 1995 per TPA*
- *LETF - unable to obtain details of funding and design*
- *Sludge Washing - contingent on new tank project completion*
- *Grout Facility - shutdown pending resolution of regulatory decision on storage vaults*
- *HWVP - scheduled for completion 1999*

E.3.D.3. Characterization Programs (Sampling). As noted several times before, characterization of the waste material in each specific tank seems a necessary precursor to the proposal, design, and eventual development of appropriate processes and of the facilities required for those processes. Characterization should include the physical extent of the facility and its particular requirements with respect to materials, applicable codes, intended operation, and so on.

The subpanel interviewed personnel working with tank sampling on the core-sampling truck. Tank-waste core-sampling production rates now far exceed the capacity of the laboratories to analyze the cores, and a backlog of cores is waiting for analyses. However, the second truck is being modified now, and it is possibly that more equipment will be required to take enough samples to support completion of the characterization before the year 2000. More laboratory capacity will be required to support operation of the 242-A evaporator to the planned filling of the LERF by 1995.

The subpanel also interviewed part of the crew providing cryogenic gas/vapor sampling as part of the industrial hygiene support to work in the tank farms. Sampling has been done on six of the ferrocyanide tanks so far, as well as a series of tests on 101-SY (the "burp" tank). The equipment is truck-mounted to ensure that refrigeration support and temporary sample storage are available at the tank riser. It was noted that all tanks, both SSTs and DSTs, will have to be sampled to establish a data baseline for development of the processes required to meet the overall DOE goals of disposal and environmental restoration (Interview(s), 4/27/92).

E.3.D.4. Characterization Programs (Laboratory Testing). From the interviews conducted with solid, liquid and gas sampling personnel, clearly the rates of sample collection far exceed the current rates of laboratory testing. Capacity in Hanford area laboratories seems to be limited by the number of "hot" cells now available. Suggestions have been made that an increase in "base" funding for laboratory upgrades would solve the short-fall. The subpanel recommends that a more efficient use of resources (funds) would be to develop an overall characterization plan, including a baseline scope (both quantity and quality), schedule, and cost. The following must be definitive: minimum standard tests, other optional tests, a base number of samples to be tested (in segments, not "average cores"), the schedule for sample taking and test completion, and a detailed cost estimate for base and optional work. In addition, a change process must be in place to modify the scope, schedule, and cost as new information and needs develop.

E.3.E. Other Observations

E.3.E.1. Safety. The deteriorating conditions in the tank farms increase hazards to working personnel.

E.3.E.2. Employee Morale. Employees are generally frustrated with the working conditions, with the frequent program changes, and with the gridlock of the maintenance system. During a 50-month period, 97 changes were made in management requirements and procedures (WHC-CM-1-3); during the same period, 49 engineering changes were made (WHC-CM-6-1).

E.3.E.3. Training. WHC apparently has several training efforts underway. They are assigning operators on a five-shift basis so that one shift can participate in training while the other four shifts are working. However, recruiting training personnel is difficult, because experienced persons belonging to a bargaining unit often must take a reduction in pay to become trainers.

E.3.E.4. Budget. Budgets appear to be developed based on an escalation of previous years cost rather than on a zero-based-budget approach. Change control processes are not consistently applied to programmatic redirection. An earned-value approach seems appropriate for planning and managing the major effort required of the tank farms division. High-level goals do not seem to be supported by the application of budgets at low levels. A high percentage of the budget is expended on producing paper rather than on equipment (paper versus iron).

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APPENDIX F

REGULATORY SUBPANEL ASSESSMENT

F.1 Review Process

The review team examined regulatory issues associated with the tank-farm design and operations, including potential regulatory problems in the LLW Grout Facility operations that may have an impact on HTFO. Examples of generic issues that were addressed by the subpanel include, but are not limited to, the following:

- *Permits (Clean Air Act, Clean Water Act, RCRA)*
- *NEPA Documentation*
- *DOE Orders (Waste Management Requirements)*
- *CERCLA (Release to the environment, worker safety)*
- *FFCAs (including the TPA)*

For each of the facilities or operations, regulatory issues were evaluated at three levels:

- *Have the applicable regulatory requirements and regulations been identified; and are they understood?*
- *Have the regulatory requirements been translated into design criteria, operational procedures, or facility policies?*
- *Have the criteria, procedures, and policies been implemented at the working level; and have the permits been obtained where required by regulations?*

The following sections cover the general regulatory requirement issues that were the basis of the inquiry by the subpanel.

F.2. Impact of Federal and State Environmental Laws and Regulations

The subpanel attempted to determine whether WHC had identified at each facility the applicability of state and federal regulations on HTFO, as well as the status of compliance with these regulations. Where notices of violations under existing permits or notices of deficiency under permit applications had been received, the subpanel reviewed the plans for bringing the facilities into compliance. We evaluated regulatory requirements applicable to operations to determine how they affected policies, procedures, and practices at each facility. We reviewed available documentation to determine the extent to which WHC policies, procedures, and practices reflect the implementation of these requirements. Our review of regulatory requirements affecting HTFO emphasized the following specific areas:

F.2.A. Impact of the TPA

The subpanel paid special attention to specific milestones and WHC plans for meeting and, as necessary, renegotiating those milestones. The TPA has a significant impact on the requirements for the tank farms. Table 1 identifies specific milestones and the status of compliance with those milestones as of April 13, 1992. The process for negotiating milestones usually operates smoothly. However, the replacement of unit managers by Washington State Department of Ecology (WDOE) is an impediment because the new unit manager can reverse (and often has reversed) the position of the previous manager. WHC has met all but two of the TPA milestones, which are related to the sampling of the SSTs (M-10-06) and to the construction and operation of a mixed LLW laboratory (M-14-00). Efforts have been initiated recently to modify the TPA to get relief from the original sampling requirements. Solving the hot-cell analytical capacity problem will be required to meet sampling and characterization requirements. This issue is addressed in Appendix C (Phenomenology Subpanel) of this report.

F.2.B. Impact of the Dangerous Waste (RCRA Part B) Permit

WDOE issued a draft permit on January 15, 1992 in response to the Hanford site RCRA Part B Permit application. The draft permit was soundly criticized by the EPA and DOE-RL. (Permitting is being used by the state in an attempt to micro-manage the site.) The Hanford Part B Permit is delayed because the state imposed conditions that resulted in 225 pages of comments on the permit by DOE. The principal issues are (1) the relationship between the Draft Permit and the FFACO, and (2) the level of control resulting from the permit conditions are not appropriate and are not supported by regulatory authority. (See Hanford Site Comments on the Draft Permit for the Treatment, Storage, and Disposal of Dangerous Waste for the Hanford Facility," submitted March 16, 1992). It is estimated that from two to eight months will be required to resolve these comments and lead to the issuance of a final Part B permit. Meanwhile, the other Part B Permitting activities, such as the Grout Facility, will slow dramatically; and other related activities, notably the tank-farm expansion project, will proceed under interim status. That the tank-farm expansion project has not been discussed with the WDOE as a possible expansion under the interim status provisions of RCRA is a key issue. This is important because DOE-RL estimates that the issuance of the Part B Permit will require from four to eight years.

The RCRA permitting of the Hanford facilities is further affected by an expressed need (on Hanford's part) for WHC and DOE-RL technical representatives to spend unplanned resources to train the regulators from WDOE on the application of WAC 173-303 to the tank-farm facilities. The basis for this training is three-fold: inexperienced staff personnel on the WDOE staff; turnover in the front line management of the WDOE organization supporting the Hanford Oversight Office; and recent experience with the draft site-wide permit, resulting in substantial rework required in the permit.

Table 1

Tank Farm Tri-Party Agreement Major and Interim Milestones

Number	Milestone	Due Date[1]
M-02-00	Initiate pretreatment of DST waste. DST waste pretreatment is required prior to disposal of high-activity tank wastes. Pre-treatment supports the removal, treatment, and final disposal of wastes subject to land disposal restrictions which are stored in DSTs. Removal of the wastes from DSTs and disposal in grout or glass will allow DST space to be made available for SST waste.	TBD
M-02-01	Submit to Ecology and EPA the DST waste disposal program redefinition study ***(Draft Redefinition Study)***	Complete 12/27/92 Dale will provide the transmittal letter
M-02-02	Incorporate additional interim milestones to support pretreatment of DST waste	Complete 1/31/91
M-04-00	Provide annual reports of tank waste treatability studies.	Annually beginning Sept. 1990
M-04-01	Provide letter to Ecology describing work scope to be included in Sept. 1990 report	Complete 12/29/92
M-05-00	Complete SST interim stabilization. Complete the SST interim stabilization activities (removal of pumpable liquid from those 51 SSTs except 241-C-105 and 241-C-106. All 149 tanks, including 241-C-105 and 241-C-106 will be interim stabilized and interim isolated by September 1996	Sept. 1995
M-05-01	Interim stabilize 3 SSTs	Complete 9/30/89

[1] Date when DOE submitted documentation

F.2.C. Double-Shell Tank System

The major issues are related to secondary containment, tank integrity assessments and tank closure. In order to complete the permitting, additional data are needed on the contents of the tanks. The current limits on analytical capability capacity is inhibiting the acquisition of analytical data needed for the permit application. The status and summary of the major compliance issues associated with the Dangerous Waste Permit Application for the DSTs are outlined below.

F.2.C.A. Status

- *Revision 0 of the permit application submitted to the Washington State Department of Ecology (Ecolgoy) and EPA on June 28, 1991.*
- *Ecology review of the permit application is in progress. A Notice of Deficiency (NOD) has not been received to date.*

F.2.C.B. Major Compliance Issues. A number of compliance issues exist for the DST System. The list includes the following:

- *Secondary containment issues*
  - *-Transfer lines*
  - *-Diversion boxes*
  - *-Catch tanks*
  - *-Ventilation system*
- *Tank integrity assessments*
- *Tank closure*

F.2.D. Single-Shell Tanks

The Part A application for the SSTs was submitted in 1985 and revised in 1987. The closure plans for the SSTs is due in 2003. For retrieval from the SSTs, it is possible that DOE could request permission for conducting an expedited response action. DOE and Washington State debated, however, about whether the equipment necessary for the waste retrieval might need to be permitted. the consensus was that equipment necessary for waste removal from Tank 101-SY (a DST on the watch-list) could be handled as an action under the Interim Status of the facility, which is classified as a treatment and storage facility. However, the same interpretation may not be applied to the SST closure process.

F.2.E. Grout Facility

The grout facility is an interim status facility for which a Part B Permit is being sought from WDOE. The permit application is on hold pending the resolution of the Draft Hanford Part B Permit. Of the items identified in prior Notices of Deficiency on the permit application, only one item is open. This open item relates to the hydrogen generation rates. This remaining issue is hoped to be resolved in May 1992. WDOE has reviewed the responses to the 31 concerns that were identified earlier. (Actually, it is Brown and Caldwell that is conducting the review for the state.) Washington State has indicated that it still has concerns after review of the response to the 31 comments. At the present time, the facility is completing preparations for operation. The subpanel found no indication of the NRC ruling on the Petition from the states of Washington and Oregon and the Yakima Indian Nation for a determination of whether the waste in the DSTs is High-Level Waste (HLW), as defined in the Atomic Energy Act.

The permitting effort for the Grout Facility is worth noting because of its success. The parties involved in the permitting (WHC, DOE-RL, EPA, WDOE) have been working together as a team with the objective of effectively moving through the permitting process without the parties to the process losing the ability to exercise their respective responsibilities or to give up authority. Training in team building has proceeded successfully enough so that communications have improved and morale appears to be high, despite some regulatory uncertainties. An apparent key to this success is the close, effective, consistent communication link established by the DOE-RL contact for the Grout Facility and for the WHC representatives. Specific problems that create risks for HTFO include the following:

- *Lack of a ruling on the petition to the NRC, (which could result in a decision that prohibits the use of grout for disposal of some of the waste);*
- *An inadequate Performance Assessment, delaying the start into 1993;*
- *An incomplete Final Safety Analysis Report, with approval expected by the end of 1992, which is delaying the Readiness Review;*
- *The Readiness Review can not proceed until items above are resolved.*

F.2.F. Liquid Effluent Retention and Treatment Facilities

The subpanel reviewed the RCRA requirements under the Land Disposal Restrictions that affect operations of the evaporator, the LERF, and the planned LETF, and it evaluated the status of compliance with the Clean Water Act for any proposed discharge from the LETF to the Columbia River. WDOE has been briefed and both WDOE and EPA staff favor discharge to the soil column and oppose discharge to the river. Evaporation of the effluent has been evaluated and rejected on the basis of cost (+$30 million) and land use (+88 acres). The siting of the discharge is designed to avoid the driving of contamination already present in the soil column toward the river. A NEPA review was contained in the December 1991 Hanford Environmental Compliance Project EA Approved 27 January 1992. The Environmental Assessment has not yet been released (Ref. Dunigan). [note: The multiple levels of review at Headquarters results in delays in obtaining approval for NEPA documentation.]

A key to the discharge into the soil column is the "delisting" of the hazardous waste constituents. The Federal Delisting Petition is tied to pilot testing using actual evaporator condensate. The delay in the start up of the 242A evaporator may cause WHC to miss the TPA Milestone M-17-14B.

The Architect/Engineer contractors' schedule for submittal of plans and specifications has been submitted to WDOE and adopted by them as a set of legal milestones. The project (C-018) is designed to a 150 gal/min capacity. It was anticipated that 75 gpm would come from PUREX and 75 gpm would come from the evaporator. To date 33 potential streams have been identified and prioritized for feed to the LETF. Since the 75 gpm from PUREX was based on continual operation and is to be placed in a safe store condition, the extra capacity will offset the uncertainty in the other estimates.

At the present time DOE is attempting to secure Interim Status for the LETF (C-018). This is important since they cannot proceed with construction if the facility is not under Interim Status. Obtaining a RCRA Permit for the facility will take three years or more and would cause a severe tank space problem as well as delay other aspects of the Hanford TWRS program.

F.2.G. Clean Air Act

Permits under the Clean Air Act have been obtained for HTFO. These permits will expire in August of 1993. Any new facilities or modifications of existing facilities will require review by the state of Washington State Department of Health. (It should be noted that the state requirements are more stringent than the federal requirements.) A package was submitted to the state on March 5, 1992 in response to a part A-114 request. Efforts are currently underway to determine what facilities will have to comply with the measurement requirements of Subpart H of the National Emission Standards for Hazardous Air Pollutants (NESHAPS). The Washington State Department of Health audited the tank-farm area during the week of April 6, 1992, but the results have not yet been provided to WHC.

F.2.H. CERCLA and RCRA Interface Issues

The subpanel identified CERCLA and RCRA interface issues for retrieval operations and reviewed plans for addressing these issues. The roadmap for the SSTs was prepared in January 1991. With the decision in December 1991 for the TWRS, a Decision Plan was drafted with the latest revision (0-B) released on March 27, 1992. It was generally believed that the removal of the contents from the tanks could proceed under Interim Status, until the Part B Permit was obtained. If a permit is required, the state will require approximately four years to process the permit. To base planning on proceeding under Interim Status will induce programmatic risk.

F.2.J. Other Issues

Inadequate technical competency of the regulatory agency staff was a recurrent theme throughout the responses to the subpanel's line of inquiry. The turnover in the first-line management staff within the contractor organization and the insufficient regulatory staff at DOE-RL are other key issues. Each issue consumes, or appears to consume, large sums of time in closing on permitting actions.

F.2.J.1. Absence of data. Lack of adequate data on the composition of waste in the tanks is delaying the completion of RCRA Part B permits for the tank farms and grout facility. The data is needed to satisfy TPA milestones M-01, M-03, M-10, and M-20. At the present time, the analytical laboratory capacity at Hanford for radioactive and mixed wastes with radiation greater than 10 mrem/hr is not sufficient to meet the demands of the multiple programs. The result is that operations permits cannot be issued by WDOE for tank farms, or the Grout Facility, since WDOE does not have adequate data to establish permit conditions for operation of the facilities.

Whereas much of the waste analysis does not require extensive, high precision analysis, the large number of samples required to obtain the needed information is resulting in an analytical-sample-processing schedule that may not provide all the permit-required information until 1998. This could extend to the year 2000 under less favorable conditions, such as competition for laboratory service with analyses needed for resolution of safety issues of the Watch List Tanks.

The importance of this waste analysis can be seen by reviewing Figure F-1, which illustrates the multiple requirements for the analysis and indicates the items that are dependent on the results. The recent integration of the sampling needs is a step in the right direction because it attempts to quantify the demands on the laboratory facilities. However, the emphasis remains on meeting the demands of the current project schedules and does not account for new needs that might be identified, nor does it allow for accelerating the analysis to enable the obtaining of needed information earlier than called for on the basis of current planning. (It should be noted that the analytical schedules developed for projects were based not on when the information would be needed, but on when it could be obtained.)

[See Appendix C (Phenomenology Subpanel) for additional information on the laboratory capability and capacity.]

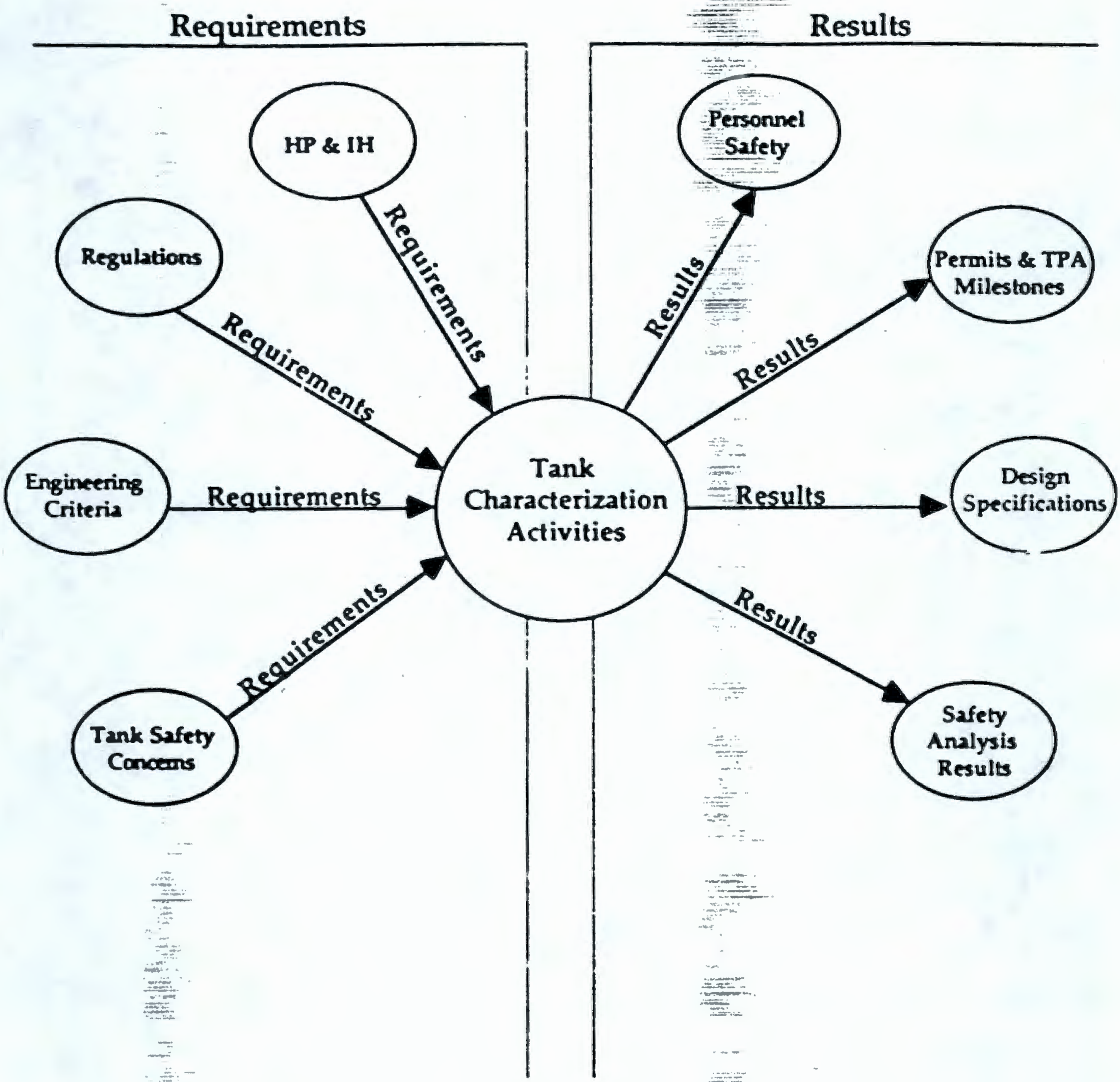

Figure F-1. **Laboratory Capability and Capacity is the Critical Path in Making "Things Happen."**

F.2.J.2. NRC and WDOE Indecision. Regulatory indecision by the NRC (see section F.2.E) and WDOE results in increasing vulnerability to third party lawsuits that could delay projects and increase waste management costs. The states of Washington and Oregon, and the Yakima Indian Nation have petitioned the NRC to rule on whether the contents of the tanks that will feed the grout facility are HLW or LLW, as defined in the Atomic Energy Act. This is crucial to determining the acceptance of the grout as a LLW form for the on-site disposal of the contents of these tanks in vaults. The only indication of the NRC position is contained in a September 26, 1989 letter from Robert M. Bernero of NRC to Mr. A. J. Rizzo of DOE. In that letter, Mr. Bernero states "The NRC agrees that the criteria (*emphasis added*) used by DOE for classification of the grout feed as LLW are appropriate. Therefore, the grout facility for the disposal of the DST waste would not be subject to our licensing authority." The letter goes on to say: "Given the uncertainty in the actual radionuclide inventory, we endorse your plans to sample and analyze the grout feeds before disposal in an effort to control the final disposition of the grout feed. If in the course of conducting this sampling program, you find that the inventories of key radionuclides entering the grout facility are significantly higher than you now estimate, you should notify us so that the classification of the waste can be reconsidered." Thus, until the sampling of the waste is complete, the NRC cannot rule on the classification of the waste.

Similarly, the questionable likelihood of timely RCRA Part B Permit issuance for the new facilities could put projects at risk. Because the lead time for issuance of a Part B permit can be four years or more, construction of the LETF and the new Waste Tanks as Interim Status Expansions has been discussed. Although this approach would solve the problem of not requiring a permit from WDOE, some risk remains that allowing such construction may exceed the authority of WDOE. If the construction does exceed the authority, litigation brought by a third party may result in the issuance of an injunction to halt the project until the permit is issued. Meeting project schedules is thus questionable. Moreover, the only evident contingency is to continue to renegotiate the project and TPA milestones.

F.3. Status of Compliance with DOE Orders

The inquiry focused on the DOE 5400 and the DOE 5800 series orders, with emphasis placed on the NEPA Order 5440.1D and Waste Management Orders 5400.3 and 5820.2A, Radiation Protection Orders 5400.4 and 5400.5, Safety Analysis Orders 5481.1B and 5480.23, and Technical Safety Requirements in DOE Order 5480.21. The interconnections of these orders with the evolving regulatory requirements and inter-agency agreements (TPA) was also explored and assessed.

An indication of the efforts to convert the requirements of regulations and DOE Orders into WHC Guidance is seen in the Solid Waste Management Manual (WHC-CM-5-16) and the Environmental Compliance Manual (WHC-

CM-7-5). The Environmental Compliance Manual was first released in September 1988, and has been updated as new information becomes available.

Applicable federal and state regulatory requirements appear to have been identified for tank-farm activities. They appear to have been integrated into compliance-related subelements of the tank-farm operational procedures. The implementation of these requirements into actual work at tank farms is the limiting function: that is, the actions taken to comply with the orders and the procedures consume significant time before activities can be conducted. The paperwork to obtain approvals within WHC for work packages of one or two days' work sometimes requires months to process. Most of the time spent was tied to the new safety analysis process, to the operational readiness reviews being conducted for actions, and to the modifications to the activity data sheets required by any perturbations in the planned work.

Internal implementation of compliance requirements, rather than the requirements themselves, appeared to be impeding action markedly. The compliance actions at the Hanford Tank Farms are proceeding favorably, with the notable exceptions of the facility hazardous-waste-permitting actions noted elsewhere in this report, the continual renegotiation of certain TPA milestones, and the inevitable maturation of the regulatory compliance process established by the TPA.

F.3.A. <u>NEPA Requirements</u>

The subpanel reviewed implementation of the NEPA process under DOE order 5440.1D, with emphasis placed on identification of ways to reduce the time and expense required to comply with NEPA requirements. Of all the regulatory issues discussed, the requirements under the NEPA caused the greatest concern. Nevertheless, the subpanel found that with few exceptions, NEPA compliance was not the cause of delay for any activity. Although it is true that the potential exists for compliance to be a problem in the future, problems will occur only if no attention is given to incorporating NEPA compliance into the planning for the project.

Although the tank farm wastes were discussed in the Hanford Defense Waste EIS in 1987, the disposal of the SSTs were not addressed. It is currently anticipated that a Comprehensive Supplemental Environmental Impact Statement (CSEIS) will be prepared. The Notice of Intent is expected to be issued in July 1992. No schedule has been developed for the preparation of the CSEIS. (The potential exists for the Draft CSEIS to be issued between June and August, 1993, with the final CSEIS to be issued betwee June and August, 1994, with a Record of Decision in the Fall of 1994. NEPA compliance issues are being worked to provide a more centralized, consistent approach. A C.2 analysis prepared in March 1992 (addressing the current tank-farm status as compared with the discussion in the Defense HLW EIS prepared in 1987 and the Record of Decision in 1988) concluded that the Grout Facility was adequately covered in the 1987 EIS.

In general, the NEPA process is improving. The NEPA Compliance Officer (NCO) has been able to effect a productive working relationship with the Richland NEPA Council which is composed of a representative from each contractor organization (WHC, KEH, PNL, and the Hanford Environmental and Health Foundation) and DOE-RL, to improve the process of NEPA compliance activities at Hanford. For the tank-farms activities, NEPA also appears to be improving, both in time and utility. Much of this improved process flow is attributable to efforts by DOE-RL and DOE-HQ to keep NEPA off the critical path of program/project scheduling. Given the delegation of categorical exclusions determinations to the Field Office by EM-1, expedition of the processing of categorical exclusions is evident by the (diminished) backlog of only six outstanding categorical exclusions. Nevertheless, many instances were found where reviews of NEPA documents took months longer than anticipated.

Whereas a NEPA strategy has been developed for the TWRS, the subpanel could not identify a single individual with the responsibility for the EA-EIS NEPA documents enroute to DOE-RL-HQ. The issue is important because no integrated plan with performance accountability is evident to ensure meeting the HQ goal of keeping NEPA off the critical path. Whereas DOE-RL has responsibility for completion of all pertinent NEPA documentation, actual analyses and documentation are delegated to the WHC project or program. The budget for the NEPA analysis is established with the preconceptual design package, before any of the detail design has begun, and clearly before approvals have been given by all signatories to the appropriate NEPA action.

Once funded, the project/program, in turn, delegates the work to an NEPA support group that functions independently from the specific project or program. Competing demands for resources disperse the responsibility for specific NEPA actions among many people. Specific individuals are identified as responsible for overseeing the development of the EIS, but no individual with the necessary NEPA experience has been identified with the responsibility and authority to ensure that the TWRS NEPA compliance activities are planned and completed. No performance accountability is established.

The NEPA process thus looms as a likely critical-path item in project scheduling simply because it has not been "owned" at a level commensurate with its importance. A case in point is the need to prepare the CSEIS and the appropriate documentation for the new tanks. Given the length of time it took to produce the HLW EIS, effective management of this CSEIS will be crucial if actions to support the TPA milestones are to proceed. In fact, the EIS will be pivotal in the decisions to move ahead on the TWRS. The current Draft TWRS Decision Plan does not include a strategy or schedule for the preparation of NEPA documents!

In spite of recent NEPA "process" improvements, a legacy of perceived excessive NEPA time/resource expenditures, as well as subsequent impacts on projects/programs, continues at Hanford. Representatives from DOE-EM-22, (who happened to be in Richland for an oversight assessment during the Red Team review) flatly stated that the HQ goal is to keep NEPA off the critical path for any project or program, and to attempt to expedite NEPA reviews. However, their efforts were thwarted by ineffective project and program planning. At the same time, NEPA documents, such as the EA for the Mobile Office and Change Room Facilities (200 West Area), were 49 weeks in DOE-EM review. Thus the critical path item is often the review of the NEPA documentation not the preparation.

F.3.B. Waste Management Requirements

The subpanel reviewed the implementation of waste management in conformance with the requirements of DOE Order 5820.2A. The radiological As Low As Reasonably Achievable (ALARA) program at the tank farms appears to be in very good condition. The contractor pressed forward with a new radiation protection manual (approved and implemented in 1991) that became the basis for all Westinghouse GOCO RadCo manuals in August of 1991. Compliance plans were prepared for all contractor organizations in March of 1992.

Keeping exposures at existing levels while accomplishing significantly more work is the basis for continued progress in radiation control. Sufficient characterization of the hazardous chemical components in the tanks (both liquid and gaseous) to predict, and thus prevent or mitigate, workers exposure is the issue of concern. Given the chemical "soup" in some of the tanks, the long lead times in securing analytical data/information, and the heightened level of concern fhe workers, progress is (and will continue to be) affected by the ultra-conservative approach of having workers in fresh air apparatus every time they must work in the tank farms. This automatically reduces efficiency and increases the risk of industrial accidents.

WHC prepared and submitted facility effluent monitoring plans (FEMPs) for the tank farm and for 242-A evaporator facilities, pursuant to DOE Order 5400.1. The effective dose equivalent (EDE) to the off-site public from radionuclide emissions of the 242-A evaporator exceeds the limit of 0.1 mrem/yr. An analysis of the facility compliance status with applicable requirements is presented in the FEMPs. Specifically, in Chapter 14 of each respective FEMP, WHC identified deficiencies for: (1) the airborne effluent sampling and monitoring system for the tank farms 296-A-40 Stack at the AP Tank Farm; and (2) the 242-A Evaporator stack effluent flow-rate monitor with flow totalizing capability for both the vessel-vent and the building-ventilation stacks. These deficiencies were then followed by recommended system upgrades. What is not clear is the fate of the assessments—who has responsibility for initiating actions to address the noncompliance issues.

F.4. Identification of Interface Issues.

As a result of the TPA, regulatory requirements interface with HTFO not only because most facilities require a RCRA Part B Permit but also because NEPA compliance applies to all major activities with a potential for significant impacts on the natural environment. The status and impact of each of these have been addressed in other appendixes.

The greatest impact on the planning for a project is the failure to account for the time required to address the requirements, either under the Permitting or under the NEPA review. At the same time, the need to identify a single individual for the lead in each of these areas is critical if the requirements are to be met in a timely manner. The failure to have a vital strategy, with a single individual responsible for the preparation of the NEPA documentation for the TWRS, could be a major impediment to the completion of retrieval activities on an expedited schedule. Similarly, the continued handling of new projects as expansion under Interim Status involves the considerable risk that either the request will be denied by WDOE or a third party suit will determine that the WDOE has overstepped its authority in granting the request.

F.5. Documents Reviewed

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- Smith, E.H., Boover, et al. 1991. Regulatory Compliance Analysis for the Closure of Single Shell Tanks," WHC-EP-0404, Rev 1.

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Design Criteria

- Kendall, B.A. 1991. Functional Design Criteria, Multi-Function Waste Tank Facility, Project W-236. Westinghouse Hanford Company. (Preliminary) November.
- Boomer, K.D. et al. 1990. Functional Requirements Baseline for the Closure of Single-Shell Tanks. Westinghouse Hanford Company. WHC-ED-0338 Draft. June.
- Cejka, C.C. 1990. Functional Design Criteria. Replacement of the Cross Site Transfer System. Westinghouse Hanford Company. WHC-SD-W058-FDC-001, Rev. 0. June.
- Westinghouse information packet, "W-058 AND W-236," Presented to Red Team. April 15, 1992.
- Westinghouse Hanford Company. 1992. Hanford Tank Waste Remediation System, Presentation to Red Team, April 13.
- DOE-RL-91-37. 1991. Hanford Mission Plan. October.

Tri-Party Agreement

- Hanford Federal Facility Agreement and Consent Order 89-10, Rev. 1. First Amendment, August 1990.
- Hanford Federal Facility Agreement and Consent Order. 1989. May.
- Hanford Facility Agreement and Consent Order, Amendment 3, Change Form M-17-91-05. 1992. March.
- Morrison, Ron. 1992. Tri-Party Agreement Integration Presentation. April 6-9. 1992.
- Hanford Federal Facility Agreement and Consent Order, Change Numbers M-01-09-3, M-02-71-1, M-03-09-2, M-05-09-03 Rev. 1, M-10-70-2, M-12-90-4, M-20--9-4, M-24-91-3-1.
- Independent Engineering Review of the Hanford Tank Waste Disposal Strategy, DOE/EM-0056P, October. 1991.

RCRA Permits

- Draft Permit for the Treatment, Storage and Disposal of Dangerous Waste. Washington State Department of Ecology and U.S. Environmental Protection Agency -- Region X. January 15, 1992.
- USDOE, WHC and PNL. 1992. Hanford Site Comments on the Draft Permit for the Treatment, Storage, and Disposal of Dangerous Waste for the Hanford Facility. March 16.

RCRA Permits (continued)

- **Comments on the Draft Permit from:**

  Hanford Education Action League
  Heart of America Northwest
  Oregon Department of Energy
  Mike Conlan
  Virginia Newell
  U.S. Ecology
  Department of Health, state of Washington
  Washington State Department of Transportation
  Laurie Cross
  Cyndy deBruler
  Larry Caldwell
  Ann Ziegler
  Charles R. Norris, Representative, state of Oregon
  Liss Witt
  Bonneville Power Administration
  Patricia Herbert
  Confederate Tribes of the Umatilla Indian Reservation

Part B. Permit Applications

- U.S. Department of Energy. 1991. 242-A Evaporator Dangerous Waste Permit Application. DOE-RL-90-42, Rev. 0. June.

Manuals

- Westinghouse Hanford Company. 1988. Environmental Compliance. WHC-CM-7-5, Rev. 44.
- Westinghouse Hanford Company. 1989. Solid Waste Management. WHC-LM-5-16, Rev. 2.

Private Communications

- Paul Dunigan, 4/27/92

APPENDIX G

MANAGEMENT AND CONTROL SUBPANEL ASSESSMENT

G.1. Review Process

The Management and Control Subpanel evaluation focused on the areas of: (1) planning, (2) implementation, (3) interfaces and integration, and (4) risk and contingency management. The subpanel's initial focus was on overall TWRS management, the relationship of TWRS management with DOE-RL management, and the TWRS budget and planning process. In addition, the subpanel made a special inquiry into the zero-based budget planning process. We then reviewed a draft copy of an earlier study entitled "Hanford High Level Waste Program Lessons Learned Review" and concluded that many of the observations in that report were similar to our findings of the first week. Thus, to avoid redundancy, we narrowed our focus to Tank Farm management and control activities.

The results, findings, and conclusions of this assessment are based on many interviews, on reviews of formal documents, on presentations, and on other handouts. Hence, the review was not performance-based because we did not make formal observations of work activities. The dynamic conditions present in the TWRS resulted in management responding to the latest crisis, which complicated the assessment effort. We categorized our findings and observations into four areas: Management Processes, Tank-Farm Status, Budget, and Planning/Scheduling.

G.2. Management Processes

The goals and objectives for operation of the TWRS and the tank farm appear to be defined and understood only in the most general sense. At higher levels of management, the current budget or safety crisis diffuses focus on stated goals. Goals and objectives are usually not coordinated or well-defined between DOE-RL and WHC. That goals of the Tank Waste Disposal Office and the Tank Farm project office at DOE-RL differ causes particular confusion. The TWRS has two distinct goal-setting customers at DOE-RL who have not integrated and prioritized their goals for the TWRS. Additional goals and objectives are seen to be promulgated from DOE-HQ.

On a programmatic basis, fluctuating budgets hinder progress toward goals and impede integration of projects into an effective TWRS program. Continual changing (perceived and actual) of the goals and requirements is leading to frustration, and for a minority of TWRS managers, to a complete loss of sight of near-term and long-term goals . . . "forget about goals, just tell me what they want me to do and let me go do it." Within TWRS, safe operation of the tank farms is an often-stated goal, but safe operation either is not defined or is defined differently by various TWRS and DOE-RL managers.

Pursuit of unrealistic near-term goals (milestones) has an impact on the allocation of resources toward building the necessary foundation and infrastructure to meet long-term goals and commitments for remediation of the tank wastes. DOE-RL and TWRS management expressed the belief that a significant portion of the upcoming milestones will not be met, even though technically they were not yet behind schedule.

As for higher levels of DOE-RL and TWRS management, the lack of a technically sound program baseline consistent with available funding is severely hindering a transition from day-to-day crisis management to continuous and steady progress toward site clean up.

G.2.A. Leadership/Ownership

The absence of a well-defined division of responsibility for management of Hanford between DOE-EM and DOE-RL, as well as the poorly integrated organizational structure at DOE-RL, has an impact on the ability of DOE to provide the leadership needed to direct and achieve progress toward remediation of the Hanford site. No single champion could be identified at DOE-RL who had the responsibility or authority to see that the goals and objectives of the TWRS were accomplished. Tank Farm managers, most of whom have been in their jobs for less than 18 months, seem to have a clear sense of ownership of the tank farm and understand their responsibilities concerning its operation. However, the ownership of problems associated with operations of the tank farm facilities was unclear. Lack of ownership and lack of accountability for problem identification and resolution seemed to pervade the organization. At the lower levels in the organization, some feeling prevailed that management is not receptive to problems. This situation is present not only within the TWRS but also in the interface between DOE-RL and WHC.

Several DOE-RL managers believe that the recent reorganization of TWRS is effective. Other managers believe that the reorganization to be a step backwards and are waiting for the WHC TWRS organizational structure to be split up. The perception prevails that DOE-EM gives DOE-RL and WHC only days or weeks to develop plans, budgets, and milestones that they must defend for years.

Craft personnel apparently have not uniformly adopted a sense of ownership and responsibility because of the slow cultural change associated with implementation of nuclear standards. The lack of employee pride in the work environment is understandable to some extent, considering the deplorable condition of the tank farm. Plans are in place to slowly upgrade certain farms and to implement concomitantly a COO philosophy. To demonstrate the commitment of management to upgrade the tank farm and to enhance ownership among operators and craft personnel, farms A and AN are currently being upgraded.

Tank Farm management seems to be extremely frustrated because they feel that an award-fee-type contract obligates them to do everything any perceived customer requests, yet adequate funds are lacking to accomplish all of their number "one" priority items.

G.2.B. Organizational Structure

With respect to program integration, the organizational structure of WHC has improved significantly since November, 1991. Improvements are seen in integrated priorities of work activities within different TWRS facilities and in the logical reallocation of resources among these facilities. Additional organizational and program integration is desirable, but is apparently on hold pending organizational restructuring of DOE-RL. The present organization is not effectively managing change caused by the changing cultural and regulatory environments in which WHC is operating. In addition, organizational elements to manage oversight (DNFSB, OMB, Red Team, and others) are noticeably absent.

The organizational structure at DOE-RL is not sufficiently integrated to ensure proper prioritization and integration of work at the Hanford site. Nonalignment of organizational structures between DOE-RL and WHC significantly confuses the customer-supplier interface, and impedes progress at the site. DOE-RL apparently does not have the proper management organization and processes either to implement change effectively or to manage oversight activities to ensure that such activities are value added.

G.2.C. Management of Change.

The inability of WHC to (or lack of a process by which it can) manage change has had a severe impact on its ability to apply resources to goals and problems effectively. The environment in which restoration will take place includes dramatic changes in mission, changes in culture, changes in regulatory requirements, oversight activities, and new technical issues, and changing customer requirements. WHC reacts to rather than manages changing requirements. The time that is consumed by the reaction of senior management to change (crisis management) prevents time being spent on problem identification, on planning, on prioritization, and on problem resolution. The existing crisis-mode of management, translated down in real time to the lowest levels of TWRS management, affects the ability to carry out work effectively under a sustained budget.

The subpanel found no evidence of a DOE order compliance agreement between DOE-EM, DOE-RL, and WHC. Neither was there evidence that DOE-EM is assessing the impact of new requirements in the DOE orders or giving guidance on the graded approach to implementation. WHC maintains that it is not sufficiently funded to fully comply with all DOE orders, even though it has either implemented or partially implemented some DOE orders. The subpanel found no evidence that DOE-RL had agreed with or disagreed with the position of WHC on order compliance.

Neither DOE-RL nor WHC has visible management structure or processes to interpret and integrate incoming regulatory orders into an effective program that would attain compliance over a time frame consistent with risk. The approach adopted by Tank Farm management to implement MRP5.46 has resulted in maintenance gridlock (WHC's term).

The subpanel found evidence that WHC perceives oversight groups and various DOE-HQ personnel as primary customers capable of giving direct guidance. No organizational structure or effort is visible at WHC or DOE-RL to proactively manage oversight activities so that such groups can be responded to efficiently, with minimal impact on line management.

Tank Farm management seems unable to cope with their perceived multiple customers, including DOE-RL, DOE-EM, DNFSB, TAP, DOE-HQ contractors, and others. These perceived customers frequently provide direction and guidance, generally expanding scope without associated guidance on prioritization or additional funding. The following example was given: a budgeted effort to install 4 temperature probes in the FeCN tanks turned into a commitment by DOE-EM to the DNFSB to install 24 probes with no additional funding. Redirected work and reallocation of funds, which bypass the formal change control processes, have an impact on committed milestones. WHC, DOE-RL, and DOE-EM have not made use of the discipline inherent in the formal change-control process (the subpanel notes recent efforts on the art of DOE-RL and WHC to adhere to the change-control process.

Tank Farm management is struggling to adjust management programs and processes in response to current regulatory requirements so that corrective maintenance activities can be performed within a reasonable timeframe.

DOE-RL and WHC seem to lack a simple process to identify (within the DOE complex) resources that could be tapped to address emerging problems. Evidence is limited that WHC management is taking the initiative to determine how other facilities are addressing common issues or problems. Much can be gained by learning from the experiences of others; for example, WHC discussions with EG & G, Inc. about the Rocky Flats Bldg 559 ORR indicated that the efforts planned for the 242 Evaporator need to be increased.

The subpanel perceived that management was spending more time in justifying and seeking additional funds than in managing the currently funded programs.

G.2.D. Performance Monitoring

The tank farm lacks an integrated commitment-tracking system to support compliance management efforts. At least five databases track commitments, audit findings, action items, and others. These databases appear to employ different processes for closure. Little performance monitoring or trending of operational and maintenance activities is being performed. Although surveillance reports summarizing tank status and waste inventories are compiled, only limited information is available on operational activities. Historical data is extremely limited so that recently initiated trending activities will establish the only known baseline. WHC ES&H-QA oversight of tank farm activities does not appear to be effective in identifying operation problems and initiating corrective actions.

Whether existing limited-trend reports get much management visibility is unclear; it is also not clear how these performance reports are used by management, if at all. Little evidence is available to suggest that an effective structured performance monitoring program is being used to identify potential problems and to initiate timely corrective action.

Some trending of equipment status is performed by Tank Farm management, but apparently equipment status is not routinely tracked by WHC ES&H-QA. ES&H-QA oversight functions are not detecting declining tank-farm equipment conditions, resulting in increased safety and environmental risks. After the deteriorating condition of the tank farm was brought to their attention, ES&H-QA senior management took seemingly aggressive action to address a major hurdle related to safety classification of equipment that had an impact on work-package preparation.

Although aware of the increased amount of out- of-service equipment in the tank farm, lower level WHC ES&H-QA managers had not identified this issue as a source of increased operational risk, nor had they initiated efforts to identify cause or to propose solutions. DOE-RL oversight personnel at the tank-farm site are very concerned about the deteriorating tank-farm-equipment conditions and concomitant increased safety risk, and they are frustrated by the limited progress. A common perception prevails among Tank Farm management that the WHC ES&H-QA groups are compliance- or paper-oriented rather than performance-based.

Several managers appeared to be frustrated by their inability to deal with the tank farm's corrective maintenance problems. Although aware of the maintenance backlog and the deteriorating tank-farm conditions, Tank Farm management appeared reluctant or unsure of what action to take.

G.3. Tank Farm Status

G.3.A. Organization

WHC appears to have assembled a technically competent and dedicated tank-farm management team. Most managers are experienced in structured, disciplined organizations where nuclear safety standards and codes were applied. Senior Tank Farm management has expressed a vision of where they want the tank farm to be in 10 years. However, essentially all of the managers interviewed had been in their positions for less than 18 months. During their brief tenure, significant resources (manpower and funds) were diverted to the USQs, reportedly the number "one" priority.

The managers recognized many, if not all, things required for a well-run tank farm. However, the subpanel perceived that their general solution to the problem areas is obtaining more funding and more personnel.

In addition to the assignment of a large number of apparently competent managers to the tank farm, the subpanel found one other indication that top-level managers of DOE-RL and WHC recognize the need to address the deplorable condition of the tank farm. A task group of about 10 people from DOE-RL and WHC was commissioned by DOE-RL and WHC senior management to determine the barriers to accomplishing work in the tank farms and to recommend methods to overcome the barriers. One task group member told the subpanel that so far the task group had listed about 15 pages of barriers and were working on methods to overcome them. Several individuals indicated that either they or other task forces had previously reported problems and made recommendations to management but that nothing had yet been done.

Morale is often low and frustration prevails because of the inability to overcome seemingly insurmountable work control problems, constant oversight, schedule pressures, and constantly changing work scopes and priorities. Nevertheless, a nearly universal desire predominates to do good work and to improve the conditions in the tank farm. The new management team appears to have had a positive impact and management is slowly bringing about changes. The inertia preventing cultural change is particularly difficult to overcome, and little or no effort has been made to change the culture of craft personnel. Conduct of maintenance training began in the third quarter of FY 92.

G.3.B. Safety Documentation

The SARs are not current. The design basis infrastructure to support tank-farm operations is generally either obsolete or non-existent. SARs for the evaporator and for the grout facilities are nearing completion. Plans are in place to combine and revise 17 other obsolete SARs (some of which are many years old) into 3 or 4 by about 1996. Without SARs, no sound technical basis exists for OSRs, for risk assessments, for developing and categorizing safety equipment lists, for preparing operating and emergency procedures, and for prioritizing work activities on the basis of risk.

Configuration control is almost nonexistent; approximately 300 of 900 essential drawings have been revised and verified as "as-builts," of which about 10% have been entered into the site CAD system. However, some documented case of inconsistency in the 300 drawings have been verified. In addition, the underground portions cannot be walked down in the strict sense and are subject to errors in the historical information available.

Tank-farm equipment–valves, switches, lines, exhaust systems, compressors, and others–has not yet been identified. A master equipment list identifying all tank-farm equipment does not exist. The absence of configuration control has a severe impact on the preparation of work packages, development of operational and emergency procedures, implementation of COO, Conduct of Maintenance, and other DOE orders.

G.3.C. Equipment Condition

The consensus among Tank Farm managers was not only that tank-farm equipment is deteriorating—more equipment is inoperable this year than was the case one to three years ago—but also that the deterioration is continuing. It was not unusual to find equipment that had been inoperable for 6 to 12 months. Approximately one-third of the tank-farm compressors are out of service, requiring from seven to nine months for repair. The managers felt that sometimes the tank farm was operating at or near outdated limits of the existing OSRs/OSDs. The present condition of the tank farm strongly suggests that new USQs will be discovered.

The primary reason given for the seemingly long repair periods was that the equipment had to be repaired as safety-class equipment, even though much of it is 1950s and 1960s vintage. Currently there are approximately 2400 corrective maintenance items on the backlog list, of which over 400 are priority "two" items, usually meaning that they are safety-related. Risks would be decreased by repairing equipment "in-kind" until that entire piece of equipment could be upgraded to or replaced with the appropriate safety-class equipment. A general agreement prevailed that the corrective maintenance program is near gridlock.

Several individuals indicated that many preventative maintenance tasks were worthless with no identified technical basis which is a waste of manpower that could be applied to corrective maintenance. Numerous interviewees were concerned that WHC management may be degrading tank-farm conditions because funding and resources are diverted from operations, maintenance, and upgrade activities to address tank USQs which raises again the question of why the major resource allocation has been within tank farm operations rather than the site as a whole.

Planners are able to complete only two to three work packages per week. Maintenance crafts are being loaned to other facilities because planned work packages are lacking. Cognizant engineering is backlogged with equipment safety-classification activities. Because much of the tank-farm equipment is vintage 1940s, 1950s, and 1960s, long lead times are required to obtain spare parts, if available.

Many managers expressed a concern for the safety of the tank farm because of the lack of reliable monitoring instrumentation. The reliability of existing monitoring instrumentation is questionable, partly because instrument loop calibrations are not routinely performed.

Deteriorating tank-farm equipment obviously results in increased risk. The subpanel understands that the long term solution is the tank farm upgrade program. However, the subpanel also believes that WHC and DOE-RL working together can reverse the negative productivity trend in the corrective maintenance.

G.3.D. Infrastructure and Equipment Upgrades

The latest revision of the TWRS Decision Plan describes plans for significant infrastructure and equipment upgrades. The Upgrades Program was initially funded at $22 million ($14.8 million expenses, $7.2 million capital) for FY 92; however, most of these funds are apparently being diverted to Waste Tank Safety Issues. Current estimates indicate that approximately $7 million will be expended on upgrades in FY 92. The diversion of upgrade funds to waste-tank safety issues is significantly delaying and complicating the upgrades program, which in turn increases both operational and safety risks. Again the question is raised why the additional funds needed to address the waste tank safety issues are not obtained from the Hanford site as a whole.

The existing upgrades program appears to be well conceived and avoids dilution of effort; for example, current upgrade efforts and limited funds are being concentrated on the A and AN tank farms to bring them up to the desired standard so that all personnel can have a concrete example of management expectations.

G.3.E. Training

The Tank Farm Training Group, established about 18 months ago, has concentrated on operator training. A WHC centralized training group conducts training in management and supervisory skills, as well as in basic craft skills. COO training for operators began in FY 91. Conduct of maintenance training is planned for the third quarter of FY 92.

One shift of tank-farm operators had recently completed a five-week training course of basic information needed for tank-farm operations and a second shift had just begun the course. The training manager informed us that his trainers had to go to the field and walk down systems to prepare training information because equipment descriptions and technical information did not exist. The training manager appeared to have an outstanding knowledge of performance-based training and how the program should be conducted.

G.3.F. Work Activities

The Management and Control subpanel made a very cursory assessment of tank-farm work activities. Several managers volunteered comments about work activities and inefficiencies during our interviews. Generally speaking, most comments were about improvements being made in operations and how maintenance was being hindered by the implementation of the JCS.

Tank Farm management clearly recognized that problems existed with maintenance because personnel from the corporate Westinghouse Productivity Improvement Center had already studied tank-farm maintenance activities. The Productivity Improvement Center personnel identified job planning as a hindrance to progress and plan to make recommendations for improvement in June.

Recent improvements in the operations area include the following: (1) a clerk has been added to each shift to relieve the shift manager and the supervisors of routine duties (typing reports, filing, and others) so that they may use their time for field observations and direct supervisory duties; (2) a CE has been added to three of the four shifts to provide technical support to the shift manager; (3) an experienced shift coach has been added to each shift. The added staff has assisted operators with the transition to the COO mode, including the revision of round sheets, turnover procedures, and others.

Cognizant engineering is backlogged with equipment safety classifications. Engineering takes several months to complete ECNs, usually because a documented equipment design basis is not available.

Operators have no procedural guidance to direct mitigative actions if an identified tank safety problem occurs. Detection of a pending safety problem is difficult because most tanks lack functioning monitoring instrumentation. A plan to upgrade instrumentation submitted in December, 1991 is only partially funded.

Coordinating the disciplines required to support a maintenance task is often extremely difficult. In addition, the requirement to have HPs monitor workers as they exit from a tank-farm job results in considerably shortened workdays (four hours). Recently an agreement was reached to allow tank-farm workers to perform self-monitoring, although this program was not in place during our visit.

Human resource procedures do not encourage stable work groups. After six months on shift, personnel can "bid" to change from working rotating shifts to working days and to "bump" anyone who has been working days for more than six months.

Implementation of the JCS has been slow because of employee resistance, numerous signature approvals, delays in work-package preparation, lack of field walkdowns of prepared work packages, and scheduling difficulties. The J3 work order can be used to trouble shoot and identify a problem. Less than six preapproved or standard procedures are available for routine work. A substantial fraction (estimates of 30% to 60% were given to the subpanel) of craft personnel are tied up with preventative maintenance and calibrations. Work (preventative maintenance, corrective maintenance, and calibration) is often performed on equipment that either is not operating or has not operated in years (for example, the 242-T Evaporator has not run in 10 to 12 years, but preventative maintenance, corrective maintenance, and calibration are routinely performed). WHC has submitted requests to relax OSRs for the 242-T Evaporator that are awaiting DOE approval. In addition, over four months may be required to obtain approval (from DOE-EM, DOE-RL, WDOE, NEPA, and others) for work activities in a Watch List tank.

The subpanel identified the following operational concerns: (1) lack of discipline on the use of radio; (2) poor lighting in some tank farms; (3) installation of temporary systems that are then uncontrolled and thus become permanent.

G.4. Budget

G.4.A. WHC Budget Basis (Zero-based Budgeting)

WHC has completed a zero-based budget exercise and determined that the funding requirements for operation of the tank farms (in compliance with DOE orders and industry standards) was $262M. In fact, the budget process of WHC did not follow the commonly accepted precepts of zero-based budgeting. The Management and Control subpanel and the WHC representative-in-charge agreed to call the practice "compliance-based budgeting" because the cost estimates were based on full compliance with DOE orders or industry standards.

WHC independently establishes the consequences of nonperformance either as a violation of a DOE order or as a violation of an industry standard (Nuclear Power Operations). WHC established the minimum level of performance (the level below which full compliance would not be met) as the level complying with their interpretation of DOE orders or of industry standards or both. The deliverables from this effort are not clearly defined. The cost of this level of performance was established on the basis of expert estimates of manpower, material, and service requirements and was validated (S & W, funded by DOE-RL) by independent walkdowns and analysis. DOE-RL and WHC neither coordinate nor have management processes for establishing agreed-upon minimum levels of performance for budgetary purposes.

Alternative methods of performance were not identified and alternative cost levels of performance were not calculated. A zero-based budget would normally identify alternative service levels and methods, calculate implementation costs, and project future savings and break even points. These alternative scenarios would then be used to select desired levels of service and optimal methods of delivery. WHC's present inability to manage change, coupled with DOE's target-case budget being below minimum compliance levels, suppresses the incentive to analyze other alternatives.

G.4.B. Budget Prioritization

The subpanel was presented with much evidence of priority definitions and budget prioritization, but looking at the Hanford Site as a whole, came to the conclusion that WHC needs to do a better job of preparing technical justification (detailed, reviewed, and defensible) for prioritization and that DOE must take the leadership role in reprogramming funds and manpower to address the primary safety issues: waste tank safety issues and the deteriorated state of the tank farms.

Except for the TWRS (excluding the tank farm), formal risk-based prioritization is not employed at the Hanford site. At present, approximately 13% of the DOE Hanford budget is directed to the Tank Farm Operations (Waste Tank Safety and Operations). No visible set of site-wide criteria or quantitative risk assessments suggests that this allocation is optimal. DOE-EM funding allocations at PUREX, FFTF, B-plant, PFP, landlord functions, site security, and others, seem inconsistent with the idea that tank safety is number one priority.

The subpanel was told that in FY 92, the Tank Safety end function is underfunded by $20 million, despite being the number one priority (for example, organic and vapor studies are currently funded at a very small programmatic planning level). Similarly, the FY 93 Tank Safety budget is flat, with the result that numerous safety-related tasks will not be funded.

Base-safe operation of the tank farms and USQs are alternately identified as the number one priority within the TWRS and even across the Hanford site. The Decision Plan establishes tank safety issues as the number one priority and "safe and environmentally sound storage of tank wastes" as number two. WHC-EP-0524 establishes "safe operations base case (near term)" as number one and USQ work as number two. "Base-safe operation of the tank farms" is not defined. Base-safe operations within the tank farms and resolution of USQs compete for the same set of resources without a clear understanding of the definition of base-safe operation or without a clear mechanism for establishing the optimal allocation of resources.

The management structure at DOE-RL is not sufficiently integrated and does not possess the necessary management processes to ensure the proper establishment of priorities across the Hanford site and subsequent optimal allocation of DOE and WHC resources. Organizational structure at WHC has improved significantly since November, 1991, but is still not sufficiently integrated to ensure optimal budget prioritization and planning, especially with respect to technology development, QA, and safety oversight.

Resources allocation is driven by TPA milestones at the expense of tank safety. For example, funds were expended to core-sample tanks (a TPA milestone activity) that the lab facility cannot analyze in the near future, whereas funds are not available for the effort to generate as-built drawings needed for timely and safe tank-farm operation in the near term.

In December, 1991, DOE-EM issued a letter directing that the construction of four new tanks be accelerated to completion in 1996, to pretreatment by 1997, and to HWVP by 1999. Essentially everyone with whom we discussed this subject thought that these dates were unachievable. The effort to accelerate work to meet such unrealistic milestones will result in increased operational and safety risk, in improper allocation of funds, in further project delays, and ultimately, in increased cost.

In some instances, money seems to be spent unwisely or on unfunded activities. Maintenance is performed on shut-down equipment that will never again be operated.

G.4.C. Change Control (Budget) Processes

WHC, DOE-RL and DOE-EM do not interface in a customer-supplier mode where performance, cost, and schedule are understood, agreed to, and where cost and schedule are adjusted according to changes in requirements. Although change-control processes are substantially defined and agreed to by WHC and DOE-RL, they are infrequently applied. WHC continues to perform unfunded (apparently by DOE-RL and WHC consensus), low-priority work without applying change-control processes, neglecting prior commitments to milestones.

The subpanel was told that the FY 93 budget would be based on ADSs and that DOE-EM approval would be required for any revision to an ADS. Nevertheless, promulgation of official and unofficial direction from DOE-EM and others without associated budget prioritization, guidance, or utilization of the formal change-control process, has resulted in local reprogramming of priorities by WHC, usually without the knowledge of DOE-EM. If left unchecked, this situation will ultimately lead to counterproductive micro-management of the TWRS by DOE-EM.

Failure to fully define the requirements (cost, schedule, performance) and to rigorously apply a change-control process is resulting in continual budgetary crises, preventing effective management of tank-farm facilities and resources.

In FY 91, over 80% of work was "level of effort," whereas in FY 92, a concerted effort has been made to tie work activities to specific milestones. DOE-RL anticipates that WHC will not attain over 50% of the milestones tracked.

G.5. Planning and Scheduling

G.5.A. Status

WHC has created several good planning documents, for example, the "Waste Tank Safety and Operations Program Management Plan," (WHC-EP-0524, 1992) and the current effort to rebaseline the TWRS. It appears to the subpanel that the weaknesses lie in the contigency planning and the implementation. The current operations can best be described as management personnel engrossed with the current crises while business-as-usual diverts resources from the long-term goals and objectives of the planning documents.

A major weakness in the current planning is the unrealistic schedules developed to meet the TPA milestones. WHC must address this problem immediately and directly with DOE because while only two milestones have been missed to date it is likely that more of them will be missed in the near future.

G.5.B. Risk Basis

TWRS prioritization and planning is not based on formal programmatic or safety-risk assessments, which also appears to be true for the Hanford site as a whole. We found no evidence of plans to perform an integrated rebaselining study for the Hanford Site, of which the new TWRS baseline would be an integral part.

WHC's local reprioritization of work in response to changing requirements (self-imposed and external) is often carried out without the knowledge of DOE-RL or DOE-EM. Thus, DOE is in the position of assuming unknown levels of risk with little or no knowledge of having done so.

G.5.C. Technology Development

Hanford waste-management activities will require significant technology development efforts. No evidence was found that the funding for technology development either is at the right level or is being optimally applied.

G.5.D. Upgrades

Although the technical planning for upgrades is available, the project has been executed in fits and starts as funds are allocated and rescinded. This is especially true for as-built drawings that are required for development of SARs, OSRs, operational and emergency procedures, risk prioritization of resource allocation, identification of safety equipment, and others. The cost associated with not aggressively improving the tank-farm infrastructure in the near term will be compounded in the future by further equipment failures and unnecessary increased risks.

G.5.E. Planning Integration

Activities within HTFO are not conducted with a consistent, integrated, and prioritized plan. For example, tank-farm engineering resources are not allocated according to a prioritization scheme integrating the four end functions (upgrades, tank safety, management and operation contractors, characterization) supported by engineering. The highest priority of one end function gets attention even though, in reality, it would be a low-priority task if the priorities of all four end functions were integrated.

G.5.F. Contingency Planning

The currently available baseline does not consider the programmatic risk associated with delays in projected milestone completion. Some examples are the delayed start up of the 242A evaporator, failure to obtain critical Part B permits, failure of the grout facility to operate as expected or grout determined to be unacceptable, discovery of new USQs, and others. The present condition of the tank-farm facility and limited knowledge about all of the tank contents strongly suggests that new USQs will be discovered. No evidence was found that this is being considered in future planning.

The strategic planning process has not included unforeseen contingencies (either the evaporator does not start up when scheduled or an extended shutdown occurs; grout does not operate as expected; the planned radionuclide content of the grout is deemed unacceptable; the new waste tanks are not completed on schedule; the new interarea transfer line is not completed when needed; and so on). Issues related to the evaporator demonstrate poor planning, such as a budget inadequate to meet an ORR to ensure that the evaporator is up to current commercial nuclear standards; a $2 to 3 million overrun to accomplish additional upgrades; and failure to consider that RCRA requirements to sample evaporator feed will require batch-mode operations. This situation is expected to reduce the evaporator throughput from 12 million gallons per year to 4 million gallons per year.

The inability of management to plan, prioritize, identify, and stop nonvalue-added activities is compromised by the amount of time directed toward crisis management and the quest for additional funding.

G.5.G. Reconciliation of Milestones with Resources

Milestones are set and committed to without first reconciling the impacts of budget, the present condition of the tank farm, the level of resources available, the proper prioritization of the milestone relative to safety and programmatic risk, and the schedule for completion of the milestone. Many examples of dual commitment of the same resources were found.

G.6. References

The following list of references includes most of the formal documents we reviewed. Additional informal handouts were obtained during and in follow up to individual interviews.

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- WHC-SD-WM-PLN-028, Rev. 1, "Waste Tank Safety Classification Implementation and Configuration Management Compliance Plan," J. M. Vann and S. D. Riesenweber, December 23, 1991.
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- WHC-EP-0405, Draft A, Vol. 1 & 2, "Systems Engineering Study for the Closure of Single Shell Tanks," K. D. Boomer, August, 1991.
- WHC-EP-0182-42, "Tank Farm Surveillance on Waste Status Report for September 1991," B. M. Hanlon, September 1991.

- WHC-EP-0399, Rev 1, Predecisional Draft,"Fiscal Year 1992 Program Plan for Evaluation of Ferrocyanides in the Hanford Site Waste Tanks," R. J. Cash, et. al., January, 1992.
- WHC-EP-0426, Rev 2, "Waste Tank Safety Programs Overview Plan," K. A. Gasper, I. E. Reep, January, 1992.
- WHC-EP-0182-45, "Tank Farm Surveillance and Waste Status Summary Report for December 1991," B. M. Hanlon, February, 1992.
- "Hanford Tank Waste Remediation System Implementation Plan," Harmon to Antonnen, Letter #9158421-R1, January 27, 1992.
- 91-AMD-002, "Secretary Decision Concerning the Tank Waste Remediation System, Hanford Site," Antonnen to Anderson, President Westinghouse Hanford, December 27, 1991.
- "Daily Operating Report - Tank Waste Operations," April 24, 1992.
- "Conduct of Operations - Targets for Accelerated Implementation (Update) Draft."
- DOE/NS-0001P, "Report on the Handling of Safety Information Concerning Flammable Gases and Ferrocyanide at the Hanford Waste Tanks," (Blush Report) July 1990, DE91 001236.
- WHC-EP-0392, "Tank Farm Upgrades Program Plan," J. M. Henderson, June 1991.
- WHC-CM-1-3 Section MRP 5.46, Rev. 4, "Safety Classification of Systems, Components, and Structures," August 28, 1991.
- WHC-CM-2-5, Section 4.1, Rev. 1, "Change Control," January 10, 1992.
- WHC-EP-0524, Appendix B, "Waste Tank Safety and Operations Program Change Control Process."
- 76000-91-128, "Plant Performance Status for July 1991," August 28, 1991.
- 7C100-92-040, "Plant Performance Status for February 1992," April 2, 1992.
- "Procedure for Restart of Reactor and Non-Reactor Nuclear Facilities," USDOE, W. H. Young to Claytor, et al., January 3, 1992.
- "Fiscal Year 1992 Funding Issues", Anderson to Wagoner memo. No. 9251971, April 2, 1992.
- "Fiscal Year 1992 (FY 92) Site Baseline Management", Wagoner to Anderson memo, March 3, 1992.
- "Fiscal Year 1992 Waste Management Program Prioritization", presentation by Becky Austin to John Tseng, October 2, 1991.
- "Post EM-30 Midyear Review Summary", Wagoner to Duffy memo, April 10, 1992.
- "Fiscal Year 1992 Funding Issues", draft Wagoner to Anderson memo, April, 1992.
- WHC-EP-0524, "Waste Tank Safety and Operations Program Management Plan," E. F. Mares, January, 1992.
- "Hanford High Level Waste Program Lessons Learned Review," draft report, March 17, 1992.

APPENDIX H

TECHNICAL ASSESSMENT PLAN

H.1. Assessment Plan

An assessment plan is prepared to guide the Independent Technical Review. The assessment plan takes its scope and objective from the DOE letter that requests the review. The detailed criteria are developed by the team members and then reviewed by both the DOE team leader and the Technical Oversight Board.

H.1.A. Background

The Independent Technical Review (ITR) of the Hanford Tank Farm Operations builds upon the prior ITRs of the HWVS and the TWRS strategy.

H.1.A.1. Objective. The objective of this technical review is to determine whether an integrated and sound program exists to manage the wastes storage and tank farm operations consistent with the Assistant Secretary of Waste Management and Environmental Restoration guidance of overall risk minimization. (DOE Memorandum, September 24, 1991).

H.1.A.2. Scope. The scope of this review includes the organizations, management, operations, planning, facilities, and safety concerns mitigation of the Hanford tank waste.

H.1.A.3. Criteria. The following are the three principal review criteria:

- *Is there evidence in the planning and the day-to-day operations that tank safety is the highest priority?*
- *Is there evidence that the tank farm operations includes planning for current and long-term operation in terms of facilities, people, training, technology, and contingencies?*
- *Is there evidence that the tank farm is an integral part of the Hanford TWRS and the DOE-EM-integrated demonstration projects?*

H.1.B. Review Team Structure

The ITR will report to DOE-Waste Management. It will consist of two organizations: the ITR team and the TOSB. Their functions are described below. The ITR was established for the purpose of creating a group of technically experienced, qualified individuals who will review the waste storage and tank farm operations, as well as their integration with the overall TWRS program. Specific areas critical to success of the overall waste tank farm operations will be identified and independently confirmed.

H.1.C. Review Process

Individuals with the requisite experience and knowledge will be selected to serve as team members to review specific technology, engineering, operations, facilities, regulations, and management of waste storage and waste farm operations. The ITR team will be divided into five subpanels that will address these items indicated below:

H.1.C.1. Phenomenology Subpanel. This subpanel is experienced and qualified with regard to the fundamental science and technology of the Tank-Farm processes. The subpanel will address the appropriate disciplines of physics, chemistry, mechanics, corrosion, etc. Analytical Facilities will also be reviewed.

H.1.C.2. Process Engineering Subpanel. This subpanel is experienced and qualified with regard to the configuration, operation, and control of the process necessary to produce a product to meet established requirements. This subpanel has expertise in the technology and equipment and in the configuration arrangement necessary to have a controllable process.

H.1.C.3. Facility Engineering Subpanel. Members of the Facilities Engineering Subpanel are experienced and qualified with regard to the design, construction, and maintenance of tank farms and related infrastructure for large, complicated, industrial processing facilities within the private and the governmental business sectors. Members of the subpanel are experienced in reviewing and assessing the functionality, durability, maintainability, and layout of tank storage and related infrastructure. Members of this subpanel are experienced in project conceptualization, project budgeting and scheduling, construction management, and facility start up and operation.

H.1.C.4. Regulatory Requirements Subpanel. Members of the Regulatory Requirements Subpanel are experienced and qualified with regard to ES&H regulatory requirements for the design, construction, and operation of the process and facility. This subpanel has the experience and training to recognize the situations and conditions under which regulatory requirements could be violated through process design, facility design, or operational practice.

H.1.C.5. Management and Control Subpanel. Members of the Management and Control Subpanel are qualified to assess the management and control of the Tank Farm operation and facilities. This subpanel has experience in the methods techniques and systems for directing and controlling a large, complex and costly operation.

H.1.D. Technical Oversight Board

The TOSB is a group of technically experienced, qualified individuals with the responsibility to review and comment on the proposed approach to be taken by the ITR team in its review. The TOSB will function as a check to assure that the scope and depth of the science and engineering review is adequate to ensure a proper, systematic evaluation. The Board will also examine the results of the review to ensure its technical consistency and to confirm that strengths and deficiencies are supported by sufficient information.

H.2. Review Team Approach

The basic processes of the review are divided into three categories: planning, on-site activities, and post-assessment activities.

H.2.A. Planning

The review team consists of technical specialists who are appropriate for the review of the Hanford tank farm operations. Training in the review method, protocol, objective, and scope is given to the team members (Accomplished Nov. 13, 1991; additional training was provided in Feb. 1992). The Team Leader or the Team Coordinator will contact the DOE-RL Operations representative, as well as the WHC program representative, before the review to discuss the specific dates for the pre-review program visit (Accomplished in notification to Ron Gerton DOE-RL, Nov. 11, 1991). After the schedule has been agreed upon, an ITR notification letter will be sent by the ITR Team Leader or Team Coordinator. It will identify the dates for the pre-review program visit and for ITR on-site activities, as well as the names of the team subpanel leaders and team members (accomplished by Fax Nov. 14, 1991). For each review, the ITR Team Leader will determine the appropriate contacts and participation of observers during the on-program activities (ITR Team Leader agreed that DOE-RL can be observers: Meeting Nov. 13, 1991). Following the pre-review visit, the team will review documentation provided by the program representative and prepare a review plan.

H.2.B. On-Site Activities

The first visit to the site is the pre-review program visit (accomplished Nov. 18-22, 1991). During this visit the team tours the facilities and receives briefings on the Hanford TWRS.

The Team Leader will begin the review with an introductory briefing to present the ITR structure, the objectives and criteria for the specific ITR, the review process, and the team members. Site or program management will have the opportunity at the kickoff briefing to present an overview of their activities and of the environmental, safety, health, and management programs. After the introductory briefing, the program management should present a detailed, overall orientation briefing. Team members will then proceed with their review according to the established agenda. They will receive briefings, review documents and files, interview program personnel, observe activities, and visit facilities as part of their information-gathering process. The Team Coordinator will conduct periodic debriefings and make ITR schedule adjustments based on the need for modification or redirection of the review plan. A closeout meeting with the operations and program representatives will be conducted at the conclusion of the on-site activities. The purpose of this meeting is to present and discuss deficiencies and to obtain clarification on points of issue.

Before their initial visit to Hanford, the subteam members will review certain published reports to enhance their knowledge of the tank farm processes. The review at Hanford will consist of presentations to subpanel members, either to individuals or to the entire group, by persons knowledgeable in the day-to-day operation of the facilities and of on-site visits to selected facilities. A proposed schedule for the first week and for the second week will be transmitted to Hanford before the visits to allow WHC and Pacific Northwest Laboratory (PNL) personnel to prepare their material.

H.2.C. Post-Review Processes

The ITR team will meet after the on-site review to prepare Draft A of the Executive Summary and the Assessment Report. The Draft A Executive Summary will be provided to the DOE-EM contact, to the TOSB, and to the DOE-RL representative. The team coordinator and subpanel leaders will prepare Draft B of the Assessment Report for review by the TOSB, and Draft B of the Executive Summary will be provided to the DOE-EM contact and to the DOE-RL representative. Draft C of the Executive Summary and Assessment Report will be provided to the WHC program representative for factual review. The final report will be published by the DOE.

H.2.D. Schedule

Date	Activity
Nov 13	Notify Operations Office of Pre-Review Visit
Nov 18-22	Conduct Pre-Review Visit
Jan 16	Preliminary Review Plan to ITR Team Leader
Jan 21-31	Team Coordinator and Subpanel Leaders Develop Review Plan
Jan 31	Fax Review Plan to TOSB, DOE-RL, WHC
Feb 4-6	Red Team at Sandia for Planning, Training, and Document Review
Feb 12	Team Leader, Team Coordinator and Subpanel Leaders Meet with TOSB
Mar 19	Subpanel Leaders meet with WHC counterparts at Hanford to lay out detailed schedule
Apr 13-17	Red Team at Hanford for Review (First Week)
Apr 27-1	Red Team at Hanford for Review (Second Week)
May 5-7	Red Team at Los Alamos to Draft Executive Summary and Assessment Report
June 4	Draft of Executive Summary to DOE-EM, TOSB, and DOE-RL

June 9	Present Executive Summary to DOE-EM and TOSB at Pittsburgh
June 24	Draft A of Assessment Report including Executive Summary to TOSB, DOE-EM, DOE-RL, and WHC for factual review.
July 22	Draft B of Assessment Report to TOSB, DOE-EM, DOE-RL and WHC
Aug 12	Submit Camera-Ready Final Report to DOE

H.2.E. Deliverable

The deliverable will be an Assessment Report of the Hanford Tank Farm Operations.

H.3. Subpanel Lines of Inquiry

H.3.A. Phenomenology

The objective of this subpanel review is to evaluate the Hanford Tank Farm and associated facilities with respect to three major items:

- *Safety problems caused by process reactions, which could cause a release of radioactivity or toxic materials or formation of potentially explosive compounds.*
- *Conditions in the tank farm that could result in failure of equipment caused by corrosion.*
- *Analytical capabilities at the site to determine if they can support the process requirements. This appraisal will be made from a phenomenological point of view.*

The subpanel will pursue the following three lines of inquiry:

- *The phenomena of the waste as it applies to the chemistry and material phenomena.*
- *Characterization of the waste, including sampling and analytical facilities.*
- *Interface issues.*

Members of the phenomenology subpanel will interact with the other subpanels, as required, to minimize the review responses required of WHC and PNL and to maximize flow of information among subpanels. The lines of inquiry are given below.

H.3.A.1. Phenomena of Waste. The subpanel will review available data and proposed programs to obtain new data to define the phenomena associated with the chemistry and material phenomena associated with the Hanford tank waste.

- *Chemistry Phenomena*

  Explosive mixtures and compounds: The panel must review the potential for explosive mixtures or compounds or both that could exist now in the waste tanks and those that could be produced during operations in the waste tanks. Potential explosive mixtures would include compounds such as ammonium nitrate, nitrate-nitrite/organic mixtures, ferrocyanides/oxidi·ers, azides, and others.

  Gas evolution: The subpanel must understand the information available and the determinations proposed to comprehend the mechanism of gas generation, retention, and release.

  Waste compatibility: An assessment must be made to determine if the existing waste, incoming waste, and outgoing waste are mutually compatible. Although most of the assessment will be concerned with existing waste, some time will be spend assessing (1) future waste, such as existing waste not in the tank farm, analytical laboratory waste, and decontamination and decommissioning waste; and (2) outgoing waste that will be sent to grout, to pretreatment, to retrieval, and to in-tank processing.

  Miscellaneous: The subpanel will assess miscellaneous chemistry issues involved in the tank waste, such as spatial variations in the tanks, possible chemical reactions that could occur, general properties of the waste, and capabilities to monitor the waste in the tanks.

- *Material Phenomena*

  Material phenomena will be addressed for the SSTs, for the DSTs, for the evaporators, for the proposed new tanks, and for the transfer lines. This assessment will be concerned with available information and programs to provide information on the phenomena associated with corrosion, stress-corrosion cracking, hydrogen embrittlement, erosion, and nil-ductility-transition temperatures (NDT), both for the present facilities and for the proposed new facilities.

H.3.A.2. Characterization of Waste. The subpanel will review existing data and proposed programs to obtain new data to characterize the waste and the sampling and analytical facilities associated with the characterization program.

- *Sampling Equipment and Program:*

  The subpanel will review the sampling equipment to ensure that the methods and equipment used to take the samples from the solids and gases in the waste tanks will provide and protect a representative sample so that laboratory analyses are representative of the material in the tanks.

- *Analytical Laboratories*

Techniques: We will assess the methods, procedures, and equipment presently used in the analytical facilities for handling, analyzing, and safety testing of the samples to ensure that they meet the waste requirements. Sample archiving, laboratory waste disposal facilities, and off-site analyses will also be assessed.

Capacity: The subpanel will review the present and proposed capacity of the analytical facilities to handle and analyze the number of samples required by the waste facilities.

Integration: The subpanel will review the analytical requirements for the Hanford waste to determine if all of the sample requirements have been sufficiently integrated.

H.3.A.3. Integration of Programs. The subpanel will assess interface issues, such as those between WHC and PNL and those among Hanford and Savannah River and West Valley. Many interface issues among the different programs at Hanford will be covered as part of the topics described above.

H.3.A.4. Documentation To Be Used In the Review.

- RHO-SA-51, Removal of Radionuclides from Hanford Defense Waste Solutions, W. W. Schulz, 1980.
- WHC-EP-0451, Candidate Reagents and Procedures for the Dissolution of Hanford Site Single-Shell Tank Sludges, W. W. Schulz and M. J. Kupfer, 1991.
- WHC-EP-0352, Single-Shell Tank Waste Retrieval Study, S. A. Krieg, et al.., 1990
- PNL-7426, Alternatives for Final Disposition of the Single-Shell Tank System on the Hanford Site, E. A. Aitken, et al., 1990.
- WHC-SD-WM T1-466
- WHC-EP-0072, Performance Assessment Technology Development for Cleanup and Disposal of Hanford Defense Waste, J. D. Davis (1988).
- SW-846 Test Methods for Evaluating Solid Waste, September 1986.
- WHC-SA-0348-FP, Statistical Techniques for Characterizing Single-Shell Tank Wastes, L. Jensen and A. Liebetrau, 1988.
- WHC-EP-0075, Summary of Single-Shell Tank Waste Characterization: 1985-1987, L. G. Morgan, W. W. Schulz, et al., July 1988.
- WHC-EP-0212, Hanford Waste Management Technology Plan, H. L. Powers, July 1988.

- WHC-SD-WM-T1-406, The History and Existing Evaluations for the Tank Bump, J. Jo and B. L. Jones, 1990.
- G. L. Gough to G. L. Danford, Hydrogen from Radiolysis in Tank SY-101, Internal Memo 82314-90-035 Rev 1, June 15, 1990.
- PNL-5441, Complexant Stability Investigation, Task I, Ferrocyanide Solids, L. L. Burger, 1984.
- Burger, L. L. and R. D. Scheele, Interim Report Cyanide Safety Studies (1988).
- WHC-SD-WM-PMP-004, Waste Tank Safety, Operations, and Remediation Project Management Plan, 1991a.
- Analytical Laboratories procedure manuals, (details of substance analyzed for and procedures used).
- Studies on waste compositions and ability to remove wastes from tanks.
- Studies on determination of waste compositions.
- Studies on corrosion and compatibility of materials with special reference to pitting and stress corrosion cracking.
- Studies on tank operating temperatures.
- Proposed materials of construction for new waste tanks and waste transfer lines.
- Single-Shell Tank Phase 1A/1B Procedure Compendium, C. J. Simiele, March 1991, WHC-MR-0213 "Analytical Procedures"
- WHC-EP-0347, Summary of Single Shell Tank Waste Stability
- Others as identified during the review process

H.3.B. Process Engineering

The objectives of the process engineering subpanel review will be twofold. The first objective is to examine and evaluate the configuration, operation, and control of the Hanford Tank Farms and ancillary facilities (evaporator, effluent treatment and disposal systems, transfer lines), as these components are currently managed, to verify that all wastes are being stored, treated, and monitored in a safe and reliable manner. The second objective is to determine whether technically sound program planning exists to continue safe waste storage and handling at these facilities and to provide a facility and waste form that is compatible and integrated with the eventual remediation methods that will be implemented at this site.

To achieve the objective of the charter, the subpanel has identified five major lines of inquiry that will be pursued during the review process. These lines of inquiry include:

- *Are day-to-day operations performed according to technically sound, practical, and monitored practices that ensure safe conditions at all times?*
- *Have tank-farm risk-reduction programs been developed to respond to immediate safety concerns, as well as to long-term and remediation-related considerations?*

- *Are tank-waste-volume projections developed in a comprehensive and technically defensible manner that adequately supports decision making throughout the tank waste system?*
- *Does the retrieval-technology-development program adequately consider the requirements of emergency retrieval and of the treatment-process?*
- *Are tank-farm-related process-engineering activities integrated with all other compo ts of the TWRS?*

These lines of inquiry will be pursued through a multiphase, iterative process that includes document review, interviews, and discussion with facility management and workers, as well as on-site inspections. Documentation will be reviewed before the site visit to gain an overview of current operations and planning. This review will also identify specific areas or questions within the lines of inquiry that suggest a programmatic weakness or that appear to require additional investigation. These areas and questions will be pursued on site by the entire subpanel or by individuals (as appropriate) to verify or refute the suspected problems. When problem areas are clearly identified, additional emphasis will be placed on exploring the specific problem areas and on establishing the overall impact on the tank-waste system. Several repetitions of document review, followed by meetings, interviews and inspections, may be necessary before an individual question or concern is resolved.

The Process Engineering subpanel will also work closely with the Phenomenology and Facilities subpanels to ensure that the process implications of problems identified by these groups are considered in the process engineering review. Similarly, problems and information identified by the process engineering subpanel will be transmitted to the other groups for consideration in their reviews. The following sections provide more specific descriptions and examples of how the lines of inquiry will be pursued.

H.3.B.1. **Tank Farm Operations.** The Process Engineering subpanel will examine day-to-day operations in the tank farms, emphasizing process safety by reviewing known hazards and potential accident scenarios. The review will begin with the previous audit reports and existing safety-related documentation. When necessary, document reviews on specific topics will be supplemented by presentations given by WHC management. Particular lines of inquiry that appear promising will be followed-up with requests for further information (including documentation). Interviews will be conducted with field operators, shift supervisors, emergency response personnel, and project engineers about their impressions of training, previous audits, work permits, operating procedures, emergency response, and the management of change. A checklist or standard set of questions for the interviews (based on recent OSHA guidelines for process operations) will be developed to allow consistent horizontal and vertical surveys through the various Westinghouse organizations. Interviews will be cle. ly coordinated with the Facilities subpanel to detect possible disconnects between operations and maintenance organizations. At least one trip to the site will be arranged for a first-hand look at the operations .

H.3.B.2. Tank Farm Risk Reduction. This line of inquiry will examine the activities underway to evaluate and respond to the identified watch-list and other potential tank-waste-safety problems from a perspective of process engineering. This review will initially concentrate on the previous tank-safety reviews and on the current plans to respond to and to reduce overall safety risks. If subpanel members identify other concerns that have not been adequately considered, the review may also expand into areas that have not yet been given high priority. We will also examine the long-term planning by WHC to resolve the problems and integrate these activities into the overall tank-waste remediation program. Specifically the subpanel will determine the status and evaluate the immediate and long-term adequacy of the following:

- *Activities to monitor gas generation, temperature, volume levels, and other internal conditions within the tanks.*
- *Safety analyses for all credible accident scenarios that may arise from the identified problems.*
- *Preparedness for emergency response to potential accident scenarios.*
- *Activities to investigate possible process solutions to identified problems (for example, additional tanks, temporary transfer lines, in-tank characterization).*
- *Tank stabilization and isolation activities.*

The emphasis of our inquiry will be to establish that all potentially unsafe conditions have been identified and that they are being actively resolved to ensure safe operation, while not creating new problems in the long term.

H.3.B.3 Tank Waste Volume Projections. The inquiry into the area of tank-waste-volume projections will determine whether the present system adequately coordinates the available tank volumes with the waste that must be placed in these spaces. This coordination must address several issues, including the following:

- *Are estimates of waste input from known generators accurate enough to allow confidence in volume projections?*
- *Is the level of actual accessible spare-tank space consistent with the confidence level of volume projections?*
- *Have all futures sources of waste input to the tanks and to other components of the tank-farm system been identified?*
- *Are estimates of availability realistic, in the long term, for the Evaporator, for the LETF, for the LERF, for the Grout Facility, and for theTransfer Lines?*

- *Does contingency planning exist to respond to unexpected decreases in treatment/disposal capacities or increases in waste volume input or both?*

The major concerns are the upstream and downstream programmatic impacts that would result from errors in the volume estimates. The safety implications of inadequate accessible-spare-tank capacity are also significant.

H.3.B.4 Retrieval Technology Development. The scope of the inquiry into the retrieval will be limited to two basic areas--emergency retrieval and retrieval to support bench scale and pilot plant testing. Specifically, the investigation will be concerned with the following:

- *Does any capability exist for emergency waste retrieval, or does a program exist for expeditious development of such retrieval technology?*
- *Will the current development program provide sufficient representative feed for bench-scale and pilot-plant-development activities in a safe and timely manner?*

The review will rely on any existing planning documentation in these areas and on discussions with WHC staff involved in the retrieval development program.

H.3.B.5. Interface Issues. Although the scope of this review has been limited to process engineering concerns with the tank farms and ancillary facility, the lines of inquiry are expected to lead to issues involving other subpanels and other components of the TWRS. Examples of interface issues that have been previously identified include the following:

- *Coordination between tank farm operations, maintenance, and "in-town" management*
- *Coordination between retrieval development and D&D programs*
- *Coordination between retrieval development and pre-treatment development*

These issues will be pursued in concert with the other lines of inquiry, when possible, and pursued as individual inquiries if the subpanel picks up indications that significant problems may exist in these areas that have potential program-wide implications.

H.3.B.6. Documents To Be Reviewed.

- DNFSB, 1991, Annual Report to Congress, Defense Nuclear Facilities Safety Board
- Tiger Team Assessment of the Hanford Site, DOE/EH/0139 and WHC response/response planning

- DOE/NS-0001, Report on the Handling of Safety Information Concerning Flammable Gases and Ferrocyanide at the Hanford Waste Tanks (Blush Report).
- Public Law 101-510 Section 3137, Safety Measures for Waste Tanks at the Hanford Nuclear Reservation (Wyden Bill), November 5, 1990
- WHC-SD-WM-PMP-004, Waste Tank Safety, Operations and Remediation Project Management Plan, 1991
- WHC-1P-0263, Tank Farms Emergency Plan, date unknown
- PNL-4688, Assessment of Single-Shell Tank Residual Liquid Issues at Hanford Site, K.S. Murphy, et.al.., June, 1983
- SD-WM-SAR-006-Rev. 1, Single Shell Tank Isolation Safety Analysis Report, D.A. Smith, January, 1986
- ARH-CD-719, Operational Safety Analysis Report - Double Shell Waste Storage Tanks, 1977
- SD-HS-SAR-010-Rev. 3, Safety Analysis Report - Aging Waste Facility, 1989
- WHC-UO-89-023-TF-06, Occurrence Report; Surface Level Measurement Decrease in Single Shell Tank 241-AX-102, 1990
- RL-WHC-TANKFARM-191-1018, Occurrence Report on Tank 241 S-302-A
- WHC-EP-0421-Rev. A, Hanford Waste Vitrification Systems Risk Assessment - Final Report, Miller, et. al.., 1991
- SD-WM-TI-220, Operating Facility Waste Generation Targets, J.M. Allison, 1986
- Daugherty, H. F., External Letter to R.F. Gerton, "Double-Shell Tank Space Management and Contingency Plan", 9001012B Rl, April 5, 1990
- Jensen, L. and A.M. Lebetrau, 1982, Internal Letter, "Waste Volume Projections Sensitivity Analysis," 65451-82-095
- SD-WM-T1-220-Rev. 1, Operating Facility Waste Generation Targets, D.E. Madle, 1989
- SD-WM-TPP-023-Rev. 6, Technology Program Plan for Double-Shell Tank Space Utilization, D.M. Nguyen, 1988
- SD-WM-ER-029-Rev. 14, Operational Waste Volume Projection, R.L. Shaver, 1990
- SD-WM-TI-309-Rev. 1, Waste Generation and Processing Rates with Volume Reduction Factors - 1990, J.N. Strode, et.al.., 1990
- Turner, D.A., External Letter to R.F. Gerton, "Revised 1990 Tank Farm Waste Volume Projections Assumptions", 9054336, dated June 29, 1990
- WHC-EP-0347, Summary of Single-Shell Tank Waste Stability, G.L. Borshelm and N.W. Kirch, 1990
- SD-WM-TI-073, Aging Waste Operational Summary, date unknown
- DOE-RL 89-16, Draft Single-Shell Tanks System Closure/Corrective Action Work Plan, 1989
- WHC-EP-0407, Action Plan for Response to Abnormal Conditions in Hanford Site Radioactive Waste Tanks,, R.J. Cash and J. Thurman, 1991
- WHC-SD-CP-LB-033, Kyshtym Explosion and Explosion Hazards with Nitrate-Nitrite Bearing Waste with Acetates and Other Organic Salts, F.D. Fischer, 1990

- WHC-EP-0426-Rev. 1, Waste Tank Safety Program Overview Plan, K.A. Gasper and I. E. Reep, 1991
- WHC-EP-0352, Single Shell Tank Waste Retrieval Study, S.A. Krieg, et.al.., 1990
- PNL-7426, Alternatives for Final Disposition of the Single Shell Tan'. System on the Hanford Site, E.A. Altken, 1990
- WHC-EP-0333, Single-Shell Tank Systems Analysis Description, J.S. Garfield, 1990
- WHC-SD-WM-TI-406, The History and Existing Evaluations of the Tank Bump, J. Jo and B.L. Jones, 1990
- WHC-CM-4-29, Nuclear Criticality Safety, 1988
- RHO-LD-124, Laboratory Studies of Complexed Waste Slurry Volume Growth on Tank 241-SY-101, C. Delegard, 1980
- WHC-EP-0137, Best Available Technology Guidance Document for the Hanford Site
- WHC-EP-0275-Rev. 2, Liquid Effluent Study Project Plan
- Hanford Federal Facility Agreement and Consent Order (Tri-Party Agreement) including Action Plan and any subsequent modifications or clarifications
- Storage, Treatment and Disposal Alternatives for the 242-A Evaporator and Purex Plant Effluent, 8/3/89, WHC document number unknown
- Preliminary Safety Assessment Document, Evaporator/Purex Interim Retention Facility, 6/1/90, WHC document number unknown
- Preliminary Safety Evaluation 242-A/Purex Plant Condensate Treatment Facility Project C-018, 4/1/90, WHC document number unknown
- Plan and Schedule to Discontinue Disposal of Contaminated Liquids into the Soil Column at the Hanford Site, 3/1/87, DOE/WHC document number unknown
- 242-A Evaporator Interim Retention Basin Hazard Classification Analysis, 12/1/89, WHC document number unknown.

General documents:

- Tank Farm Operating Procedures Manuals
- Unusual Occurrence Reports from Tank Farms Operations for 1990, 1991 and 1992
- Tank-Farm-related safety documentation (SARs, OSRs, etc.)
- Tank-Farm internal safety auditing procedures, checklists, etc.
- Tank-Farm-related NOD's received from WDOE, U.S. EPA
- Resource Conservation and Recovery Act (RCRA) Part B Permit Applications, Interim Status Closure Plans, and any issued permits covering Tank Farm related facilities
- Additional reports available on mechanical retrieval development and/or prototype testing
- Additional reports dealing with emergency planning and procedures
- Updates on material presented during last Red Team site visit as available

H.3.C. Facility Engineering

The overall purpose of the Red Team is to evaluate the schedule and/or the cost of retrieving, processing, and stabilizing radioactive, hazardous waste contained in the Hanford Tank Farms. The Facility Engineering subpanel will examine the physical and functional condition of existing equipment, the status of the maintenance program, and the organization, planning, and scheduling of new projects. The objective of the review is to identify strengths and weaknesses in the existing facility and in the proposed facility modifications. The scope of the review will include the waste tanks, the related waste-transfer piping, the equipment, the instrumentation, and the evaporator system.

The Facility Engineering subpanel will investigate the following four lines of inquiry:

- *Existing equipment*
- *Maintenance*
- *New projects*
- *Facility interfacing issues*

Each line of inquiry is intended to answer a specific question that pertains to the Hanford facility's ability to store, move and process tank waste. The review will be structured to answer basic questions that pertain to each line of inquiry.

H.3.C.1. Existing Equipment. What metrics, systems, information, and documentation are being used to measure, track, assess, and report the physical and functional status of existing tanks, piping, equipment, and instrumentation that is currently used to contain, transfer, and manage tank waste at Hanford?

The Red Team will review and assess the following:

- *Functionality: availability, reliability, and maintainability programs, systems, and data*
- *WHC's assessment of functionality*
- *WHC's current upgrade plan*
- *Facility life prediction/life extension*
- *Tank and piping structural integrity:*
  - *Seismic hardness*
  - *Conformance with civil, structural, and architectural standards and practices*
  - *Resonant frequency*
- *Waste-retrieval infrastructure and systems*
- *Contingency planning for equipment failure*
  - *Critical equipment, utilities and subsystems*
  - *Back up systems for critical system components*

- *Contingency plans*
- *Contingency response training*

H.3.C.2. Maintenance. What is the status of the maintenance program for tank farms and supporting infrastructure at Hanford? The Red Team will review and assess the following:

- *Tank-Farm work-order system*
- *Predictive maintenance/preventive maintenance*
  - *Age and condition of equipment*
  - *Effectiveness of the maintenance program*
- *Maintenance department organization*
  - *Organizational structure*
  - *Staffing*
  - *Responsiveness to operating needs*
  - *Qualifications and Training*
- *Prioritizing and scheduling maintenance activities*
- *Supporting infrastructure functions (e.g., warehousing)*
- *Coordination with operations and construction (e.g., schedule coordination and criteria for determining ownership)*

H.3.C.3. New Projects. What additions, modifications, and retrofits are being considered to improve tank farm functionality or to increase tank farm capacity or both, and when and how are such modifications going to be implemented?

- *Organization and ownership of new projects*
- *Design development and review*
  - Development of design criteria
  - Operations and maintenance input
  - Design review criteria
  - Design review process
- *Project planning, scheduling, and coordination*
- *Project management infrastructure and technical support*
- *Project stuffing*
- *Plans and schedules for waste retrieval (Tri-Party Agreement Milestones)*
- *Definition and planning of project infrastructure (e.g., roads, water, power, space, security, etc)*
- *Containment during waste retrieval*
- *New tanks*
- *New transfer lines*

H.3.C.4. Facility Interfacing Issues. What interface issues have been identified among the waste tanks, upstream waste generators, and downstream waste-treatment processes, and how have these issues been resolved?

All members of the Red Team will be alert to issues and circumstances that require the tank farms to interface with upstream and downstream processes.

H.3.C.5. Method Of Review. Documents pertinent to review by the Facility Engineering subpanel will be identified, assembled and reviewed before the subpanel arrives at Hanford. A previsit overview of the systems and issues will be constructed to assist subpanel members to identify issues that arise as a result of the on-site visit.

During the visit the subpanel will be subdivided into the following three subgroups, each consisting of two reviewers:

- *Existing equipment*
- *Maintenance*
- *New Projects.*

On-site activities will emphasize contact with facility personnel and familiarization of subpanel members with facility layout.

H.3.C.6. Major Documentation. The following is a partial list of documents that are used in the review :

- Copy of the Tri-Party Agreement
- Complete set of drawings and specifications for all tanks
- Information on how WHC and Kaiser Engineers work together for design and construction
- Equipment status documents and/or integrity assessments of equipment and infrastructure
- Open safety item lists for each area
- Complete list of current waste streams for each area
- Complete list of projected waste streams for each area
- Videos, films, and photographs that show the configuration and the current condition of waste storage, processing, and transfer facilities in each of the areas.

In addition, subpanel members will review inspection records, maintenance records, and other data that are generated in the normal course of operating and maintaining equipment at the facility.

H.3.D. Regulatory Subpanel

Examples of generic issues that will be addressed by the subpanel include, but are not limited to, the following:

- *Permits (Clean Air Act, Clean Water Act, RCRA)*
- *NEPA Documentation*
- *DOE Orders (Waste Management Requirements)*

- *CERCLA (Release to the environment, worker safety)*
- *Federal Facility Compliance Agreements (including the Tri-Party Agreement)*

For each of the facilities or operations, regulatory issues will be evaluated at three levels:

- *Have the applicable regulatory requirements and regulations been identified; and are they understood?*
- *Have the regulatory requirements been translated into design criteria, operational procedures, or facility policies?*
- *Have the criteria, procedures, and policies been implemented at the working level; and have the permits been obtained where required by regulations?*

General regulatory requirement issues that will be the basis of the inquiry by the subpanel are discussed in the following sections.

H.3.D.1. The Impact of Federal and State Environmental Laws and Regulations on Tank Farm Operations. When conducting this inquiry, we will attempt to determine whether WHC has identified at each facility the applicability of state and federal regulations and the current status of compliance with these regulations. In addition, where notices of violations under existence permits or notice of deficiency under permit applications have been received, the plans for bringing the facilities into compliance will be reviewed.

Regulatory requirements applicable to operations will be evaluated to determine how they affect policies, procedures, and practices at each facility. The extent to which WHC policies, procedures, and practices reflect the implementation of these requirements will be determined from a review of the facility documentation. Practices implementing regulations will be determined from observation of operations and from interviews with members of the work force.

The following specific areas will be emphasized in the review of regulatory requirements affecting the tank farm operations:

- *The impact of the TPA on tank-farm operations and upgrades. Special attention will be paid to specific milestones and WHC plans for meeting those milestones.*
- *Impact of the operational restrictions proposed in the RCRA Part B Permit issued by the State of Washington on January 15, 1992.*
- *RCRA requirements under the LDR that affect operations of the evaporator, the LERF, and the planned LETF. The status of the delisting petition for liquids will be reviewed and the best available*

technology for the waste streams from the evaporator will be identified.

- *Clean Air Act requirement applicable to tank-farm and evaporator operators will be reviewed.*
- *The status of compliance with the Clean Water Act for any proposed discharge to the Columbia River from the LETF will be evaluated.*
- *CERCLA and RCRA interface issues for and retrieval operations will be identified, and plans for addressing these interface issues will be reviewed.*

H.3.D.2. <u>The Status of Compliance with DOE Orders.</u> The inquiry will focus on the DOE 5400 and the DOE 5800 series orders with emphasis on the NEPA Order 5440.1C and Waste Management Orders 5400.3 and 5820.2A, Radiation Protection, Orders 5400.4 and 5400.5 Technical Safety Requirements. The interconnections of these orders with the evolving regulatory requirements and inter-agency agreements (TPA) will also be explored and assessed.

To conclude this line of inquiry, past reviews of Tank Farm Operations by the Tiger Team, other audits by WHC (such as self-assessments), UORs, and external audit reports will be reviewed. Special evaluation will be focused on the following:

- *Implementation of the NEPA process under DOE Order 5440.1C with emphasis on identification of ways to reduce the time and expense required to comply with NEPA requirements.*
- *Implementation of Waste Management in conformance with the requirements of DOE Order 5820.2A.*

H.3.D.3. <u>Identification of Interface Issues.</u> The line of inquiry will identify where regulatory requirements effecting tank farm operations interface with other WHC activities.

H.3.D.4. <u>Major Documentation</u>. The following documentation is requested for the Tank Farms, the Transfer Line (old and new), the Evaporator, the New Tanks, the Grout Facility, the LERF, the LETF, and for any treatment facilities planned for safety activities. The following documentation will be available to the team during its visit to Hanford.

- **Regulatory**
  Tri-Party Agreement
  Permits (Air Quality, National Pollutant Discharge Elimination System, RCRA Part B)

- **Audit and Occurrence Reports**
  Copies of Regulatory Audit Reports, Notices of deficiency or Notice of Violations

Tiger Team Report and Response to the Tiger Team Report
Unusual Occurrence reports

- **Planning Documents**
  Site Specific 5-year plan
  "Roadmaps" or planning documents detailing the plan for bringing facilities into compliance, or meeting regulation milestones.

- **Design, Safety, Operational Procedure Documents**
  Functional Design Criteria Documentation for the proposed New Tanks Procedure
  Systems Integration Plan (if it exists)
  Safety Analysis Reports
  Emergency Response Plans
  Operational Procedures, Conduct of Operations, or Standard practices documentation.

H.3.E. Management and Control Subpanel

The focus of the evaluation will be in the areas of (1) planning; (2) implementation; (3) interfaces and integration; and (4) risk and contingency management. The following four major lines of inquiry will be pursued during the assessment.

H.3.E.1 Review and Discuss Tank Farm Program Planning. The following topics will be reviewed:

- *The goals, objectives, definitions, and assumptions used to manage the tank farm program.*
- *The tank farm portion of the Hanford Site 5-year plan.*
- *Input/constraints that potentially impact tank farm planning.*
  - DOE prioritization guidelines and validation.
  - Funding and milestone interrelationships.
  - Resource constraints other than funding.
- *Approaches for monitoring progress will be reviewed.*
- *Change control processes associated with program planning will be reviewed.*

H.3.E.2. Review and Discuss Program Implementation. The following topics will be reviewed:

- *The management process to implement the program plan.*
- *The organizational structure to implement the program plan.*
- *Prioritization and coordination approaches.*
- *Current and planned staffing and training programs.*
- *Management plans/programs for conduct of operations, quality assurance, and ES&H concerns.*

H.3.E.3. Review and Discuss Program Interfaces and Integration. The following topics will be reviewed:

- *Tank-farm organizational interfaces and integration with other TWRS program elements (characterization, retrieval, pretreatment, and others).*
- *Tank-farm organization interfaces and integration with other WHC divisions (Environmental, Engineering, Analytical, Standby Production Facilities, and others).*
- *Tank-farm organization interfaces and integration with nonWHC organizations such as DOE-RL, PNL, other Westinghouse tank-farm sites, and others.*
- *The approach of Tank Farm management toward interfacing and tracking research and development applicable to future tank-farm operations.*

H.3.E.4. Review and Discuss Risk and Contingency Management. The following topics will be reviewed:

- *Management perspectives and programs for tank safety, tank surveillance, site emergency response, and resolution of ES&H concerns.*
- *Tank-farm operational and programmatic risks and contingency planning*
- *Historical effect of nonscheduled or abnormal events on achievement of program goals.*

H.3.E.5. Method of Review. WHC will make presentations to the full Red Team on Monday of the first week. Much of this information will give an overview of the organization and management programs. Subsequent review activities will involve interviews taking vertical and horizontal slices through the organizational structure.

H.3.E.6. Documents to be Reviewed

- Document Review Before Visit
- Tank Farm portion of Hanford Site 5-year plan.
- December, 1991 Record of Decision regarding TWRS activities.
- FY92 Tank Operations Work Breakdown Structure (Including list of FY92 funded activities)
- Relevant Program Planning Documents for Tank Farm Operations
- Strategic Planning Documents
    - Redefinition Study
    - Tank Closure Systems Study
    - Hanford Site Tank Waste Disposal Strategy
    - Conduct of Operations
    - Latest Monthly ES&H Compliance Report (if available)
    - Latest Monthly QA Report (if available)

November 1991, December 1991, and January 1992 Tank Farm Status Report to DOE

- Other documents to be defined before and during review

H.4. Review Personnel

RED TEAM	Expertise	Contact
John Tseng	Team Leader	DOE-EM
Bill Partain	Team Coordinator	LANL N-6
Philip Thullen	Consultant	LANL
Douglas Weaver	Consultant	Sandia
Phenomenology		
Claude Goodlett-Subpanel Ldr	Waste Processes	Consultant
Norm Brown	Chemist	SNL
Steve Thornberg	Analytical Laboratory	SNL
Bob Ondrejcin	Process Chemist/Corrosion	Consultant
Glenn Burney	Waste Processes	Consultant
Facility Engineering		
Bob Roberts-Subpanel Ldr	Petro-Chem/Mining	SAIC
Don Armour	Quality Assurance	Wastren
Boris Rosev	Auxilary Systems	LANL
Dave Powels	Tank Construct CBI	Consultant
Mike Orr	Construction/Project Mgmnt	Consultant
John Eargle	Radio-Chem Process	Consultant
Process Engineering		
Michael Cramer-Subpnl Ldr	Geological Engineering/RCRA	SAIC
Jim Mailen	Radio-Chemical Processes	ORNL
Roy Hardwick	Chem Engineering	H&R Tech Assoc.
Bill Thompson	Waste Retrieval/Remote	Nucl Sys Assoc
Otto Morris	Waste Operations	Consultant
John Hockert	Conduct of Operations	OGDEN
Dick Stephans	Conduct of Operations	OGDEN
Regulatory		
Barry Nichols-Subpanel Ldr	Safety/Regulatory Analysis	SAIC
Tony Rutz	Envrnmntal/Regulatory	WASTREN
Management & Control		
Stewart FischerSubpanel Ldr	Project Management	LANL N-6
Don Nichols	Waste Operations	Consultant
Glenn Lockhart	Management and Budget System	LANL FIN-DO
Dale Blakenship	Process Engineering	SNL

APPENDIX J

INDEPENDENT ENGINEERING REVIEW TEAM CREDENTIALS

Name: Don A. Armour

Position: Facility Engineering Subpanel Member

Education: AAS, NT, Eastern Idaho Technical School, 1978
B.T., QE, University of Idaho (in progress)

Affiliation Consultant, Wastren, Inc.

Experience: Over 14 years technical and managerial experience involving site characterization, design, construction, configuration management, start-up, and evaluation of commercial nuclear reactors and nuclear fuel reprocessing facilities. Currently supporting the DOE and M&O contractors (primarily the INEL) through the development of Quality Program and Project Plans, Management Plans, independent quality reviews/assessments, and implementing procedures - related to waste management, CERCLA and RCRA compliance, and Waste Minimization/Pollution Prevention.

Name: Dale Blankenship

Position: Management and Control Subpanel Member

Education: B.S., Chemistry
M.S., Chemical Engineering

Affiliation: Sandia National Laboratories

Experience: Mr. Blankenship is currently the section supervisor for operations in the Microelectronics Development Lab where he works to coordinate the effort of process and technology engineers, computer integrated manufacturing engineers, technicians, maintenance personnel, and physical resources towards the development of new IC technologies. Prior work including process engineering on thin film and chemical vapor deposition. In addition to his formal education Dale has received training in material science, electrical engineering, program and project management, and quality assurance.

Name Norman E. Brown

Position: Phenomenology Subpanel Member

Education Ph.D., Metallurgy, University of Utah, 1965
B.S., Chemistry, University of California-Davis, 1962

Affiliation: Sandia National Laboratories

Experience: Dr. Brown has been a Technical Staff Member and Supervisor at SNL since 1965. He has 8 years experience in the characterization of explosives and pyrotechnics. For nine years he supervised an analytical chemistry group responsible for analyses using Ion Chromatography, GC, HPLC, ICP, optical emission spectroscopy, neutron activation analysis, and classical analytical techniques. He was responsible for contamination control in the Microelectronics Development laboratory, specifically to identify and eliminate chemical and particulate contamination in high-purity deionized water and ultrahigh-purity nitrogen. He identified and corrected a major problem in the effluent-waste water-treatment system. Recently he has been working in process monitoring and control support of a new SNL initiative in developing environmentally conscious manufacturing.

Name: Glenn A. Burney

Position: Phenomenology Subpanel Member

Education: B.S., Chem, South Dakota State, 1943
M.S., Chem, University of Michigan, 1950
Ph.D., Chem, University of Michigan, 1953

Affiliation: Consultant

Experience: Dr. Burney was involved in uranium processing at Oak Ridge from 1943 to 1948. He has extensive experience (1953-1986) at the SRS Laboratory in lanthanide and actinide chemistry studies and in process development. The studies included anion and cation exchange for the separation and concentration of U, N_p, P_u, solvent extraction studies of U, N_p, P_u, Am, and Cm, high-pressure cation exchange for separation of Am, Cm and Cf from each other and from fission products, precipitation studies of u, N_p, P_u, Am and Cm, and dissolution studies on miscellaneous solid wastes. He has numerous publications describing the process chemistry and processes.

Name: Michael L. Cramer

Position: Process Engineering Subpanel Leader

Education: B.S., Geol. Engr., Michigan Technological University, 1979
M.S., Mining Engr., Michigan Technological University, 1981

Affiliation: Senior Project Engineer
Science Applications International Corporation

Experience: Mr. Cramer is a mining and environmental engineer with over ten years of experience in a variety of engineering and waste/ management activities throughout the country. Mr. Cramer has functioned as Senior Engineer and/or Project Manager in efforts that have included site characterization; engineering evaluation and feasibility studies; facility audits; and research and development involving hazardous chemical waste, radioactive mixed waste and high level radioactive waste.

Name: John C. Eargle

Position: Facilities Engineering Subpanel Member

Education: B.Ch.E., Chemical Engineering, Clemson University, 1950
M.S., Chemical Engineering, Virginia Polytechnic Inst., 1952

Affiliation: Consultant

Experience: Mr. Eargle has 40 years experience with Du Pont and Westinghouse Savannah River Company in operations and facility design at the Savannah River Site. From 1951 to 1978 he was with the Separations Technology Department with responsibilities in separations facilities, actinide recovery and reactor target fabrication. Following this, he worked with conceptual design of an integrated reactor fuel processing facility. From 1979 through 1991, he has worked in project engineering and management on the Defense Waste Processing Facility.

Name: Stewart R. Fischer

Position: Subpanel Leader, Management and Control

Education: B.S. M.E., Purdue University, 1964.
M.S.E., Arizona State University, 1967.
Ph.D., M.E., Arizona State University, 1970.

Affiliation: Los Alamos National Laboratory, N-6

Experience: Dr. Fischer has over 22 years experience as an individual contributor, supervisor and manager, including 10 years with National Labs., 8 years commercial nuclear power, and 4 years petrochemical. Dr. Fischer's areas of expertise include technical program management, nuclear safety oversight, independent safety review, nuclear reactor thermal hydraulics, plant transient analyses, fluid flow, two-phase flow and large computer code development/applications.

Name: Claude B. Goodlett, Jr.

Position: Phenomenology Subpanel Leader

Education: B.S., Ch.E., Clemson University, 1954

Affiliation: Consultant

Experience: Mr. Goodlett has extensive experience at the Savannah River Plant in the processes and equipment for evaporation and storage of radioactive waste, reprocessing of irradiated reactor fuel, production of high density UO_2, and production and dissolution of thoria. Mr. Goodlett performed the research and development efforts required to define the parameters for concentration of radioactive waste, including equipment required for the concentration and transfer of waste. He was responsible for development and procurement of pumps for suspension and removal of waste sludges from the storage tanks. He was involved in defining the technical limits for ensuring safe storage, including corrosion and other safety considerations, of the waste in the tanks and defining requirements for blending the radioactive waste for feeding to the Defense Waste Processing Facility. He has numerous publications in the field.

Name: Roy E. Hardwick

Position: Process Engineering Subpanel Member

Education: B.Sc. (Honors) Ch.E., Birmingham University, England, 1962. Ph.D. Ch.E., Victoria University of Manchester, England, 1967

Affiliation: Senior Engineer, H&R Technical Associates, Inc.

Experience: Dr. Hardwick has 11 years of industrial R&D experience with DuPont and with the Aluminum Company of America in polyamide yarn, chemicals, and metal production. Dr. Hardwick has 5 years of experience providing consulting services to industry in risk management, hazards identification, and process safety management. Dr. Hardwick consulted for PAI Corporation before joining H&R Technical Associates, Inc.

Name: John Hockert

Position: Process Engineering Subpanel Member

Education: Ph.D.

Affiliation: Ogden Environmental and Energy Services

Experience: Dr. Hockert has 26 years experience in analysis of technical and regulatory issues on the safety of nuclear facilities. He recently managed the Ogden Environmental and Energy Services program to provide assistance to the Martin Marietta Energy Systems K-25 Site in preparing for a DOE Tiger Team assessment. Dr. Hockert also led the Ogden effort to assist LANL in the development of evaluation criteria and guidance for safety assurance programs for nonreactor nuclear facilities and new production reactor concepts. He developed a method for determining the importance of off-site radiological emergency preparedness that was used by the Federal Emergency Management Agency and provided expert testimony on this subject to an NRC Licensing Board. To aid a nuclear facility in meeting NRC regulations, he performed an independent review of the plant's radiological emergency preparedness program and recommended corrective actions. While at NRC, Dr. Hockert led teams responsible for assessing safeguards program effectiveness.

Name: Glenn Lockhart

Position: Management and Control Subpanel Member

Education: B.B.A., University of Texas - Austin, 1961
M.B.A., University of New Mexico, 1981

Affiliation: Los Alamos National Laboratory

Experience: Mr. Lockhart has 19 years experience (NM Health & Social Services and LANL) supervising up to 85 employees. He specializes in financial analysis and management; interpreting federal regulations and negotiating with federal agencies; and planning and implementing automated accounting, personnel, procurement and inventory control, and decision information systems. He was a member of LANL CUP Task Force in 1986. He has 15 years LANL experience in salary management, data processing, and budget and decision information systems. He prepared and conducted briefings for the Governor of NM, US Congressmen, Congressional committees, and cabinet members. He was a systems analyst and audit supervisor (Zia Company), and an operations contractor for the DOE at Los Alamos.

Name: James C. Mailen

Position: Process Engineering Subpanel Member

Education: B.S., Ch.E., Kansas State University, 1959
Ph.D., Ch.E., University of Florida, 1964

Affiliation: Manager for Nuclear Fuel Cycle Chemistry, Oak Ridge NL

Experience: Dr. Mailen has 29 years experience with ONRL, studying chemical processing of reactor fuels and reactor safety, LWR reprocessing, MSBR reprocessing, LMFBR reprocessing, and HTGR safety issues relating to fission product behavior. He developed biomedical instrumentation for NASA and performed fission product chemistry studies sponsored by BES. He chaired the Operational Readiness Review Committees at the Y-12 plant (conversion of UF_6 to UF_4) and ORNL (HTGR fuel-heating studies) and the evaluation of flowsheets for partitioning actinides from LWR fuel, converting them to a form suitable for the Integrated Fast Reactor. He managed ABLIS activities, HTGR safety studies, and waste management development efforts. He is a fellow of the American Institute of Chemical Engineers.

Name: Otto M. Morris

Position: Process Engineering Subpanel Member

Education: M.S. Chemical Engineering, Georgia Tech., 1951

Affiliation: Consultant

Experience: Mr. Morris has almost 40 years experience in operations with radioactive materials at the Savannah River Plant. His final assignment was in Waste Management Technology as department superintendent. His supervisory assignments were in plutonium finishing lines, canyon separation tritium operations, heavy water, and waste management. In the area of waste management, Mr. Morris was responsible for receipt, storage, and evaporation in 51 one-miilion-gallon carbon-steel tanks. This included tank heat loads, radionuclide content, corrosion control chemistry, in-tank processing, sludge removal demonstration, and salt removal with slurry pumps.

Name: Donald C. Nichols

Position: Process Engineering Subpanel Member

Education: B.S., Physics North Georgia College, 1948

Affiliation: Consultant, Nichols Associates, Inc.

Experience: Mr. Nichols has extensive past experience in health physics environmental analysis and planning, tank farm operation and management, plant operation and Task Team Manager and Production Superintendent for the Defense Waste Processing Facility. Before retiring he was Operations Manger for the Defense Waste Processing Facility. His wide ranging experience with the design and planned operation of the Defense Waste Processing Facility is directly applicable to the review of the Hanford Waste Vitrification Project, the design of which is based on the Defense Waste Processing Facility.

Name: Barry L. Nichols

Position: Regulatory Requirements Subpanel Leader

Education: B.S. Natural Science, University of Wisconsin, 1964
Graduate Work in Botany, University of Wisconsin, 1964
Graduate Work in Ecology. University of Tennessee, 1970-1973

Affiliation: Vice-President, Sr. Program Manager, SAIC

Experience: Mr. Nichols has 28 years of experience in education, environmental studies, and Regulatory Compliance. Mr. Nichols has conducted and managed projects for Science Applications International Corporation (SAIC). Mr. Nichols specializes in environmental compliance, integrating legal interpretation, technical support, and environmental documentation. Mr. Nichols previously taught Biology, Advanced Biology and General Science in secondary schools; lectured on environmental issues associated with nuclear energy; was an independent consultant on environmental issues; founding director of the National Environmental Studies Project of the Atomic Industrial Forum (a consortium of nuclear utilities, architect-engineers, and reactor manufactures).

Name: Robert S. Ondrejcin

Position: Phenomenology Subpanel Member

Education: B.S. University of Illinois, Chemistry, 1951

Affiliation: Consultant

Experience: Mr. Ondrejcin has 30 years experience with the SRS Laboratory in the field of corrosion. He eliminated nitrate stress corrosion cracking of the carbon steel nuclear waste storage tanks, leading Hanford to adopt the same general approach. He is now assigned to the restart of SRC reactors, which involves stress corrosion cracking of stainless steel and intergranular corrosion of aluminum alloys in water. His work led to recommendations for aluminum fuel cladding in a new production reactor. He also worked on reducing the pitting, cracking and general corrosion problems in chemical reprocessing systems for nuclear fuel and targets. He spent several years elucidating a mechanism for halide stress corrosion cracking of titanium.

Name:	<u>Michael M. Orr</u>
Position:	Facilities Engineering Subpanel Member
Education:	B.A., Economics, Wabash College, 1969 M.B.A., Finance, University of Chicago, 1972
Affiliation:	President, Construction Project Management
Experience:	Over 16 years experience in Construction Management and Construction Project Management. Experienced in scheduling, planning, cost estimating, resource management and time control.

Name:	<u>William L. Partain, Jr.</u>
Position:	HFTO Team Coordinator
Education:	B.S., Electrical Engineering, Georgia Tech., 1964 M.S., Nuclear Engineering, Georgia Tech., 1968 Ph.D., Nuclear Engineering, Georgia Tech., 1970
Affiliation:	Staff Member Los Alamos National Laboratory
Experience:	Dr. Partain is currently performing independent technical reviews for DOE-EM. He has 23 years experience in the nuclear field, much of it working as a consultant in the nuclear fuel cycle. He has worked extensively on liquid metal fast breeder reactors, light water reactors, nuclear rockets, and high-level waste solidification programs. He led review teams for DOE research reactors and evaluated safety analysis reports for DOE radio-chemical plants. Recently he was on the Los Alamos independent safety review team for the New Production Reactors. He is a coauthor of MELT III a coupled thermal, hydraulic, and neutronic code for Liquid Metal Fast Breeder Reactors.

Name: Dave Powels

Position: Facility Subpanel Member

Education: B.S. C.E., Washington State (1948)

Affiliation: Consultant

Experience: Mr. Powels has thirty four years experience with Chicago Bridge and Iron in construction as field engineer, Project Manager, Construction Manager, and Operations Manager on steel construction projects. These projects included refining, waste treatment facilities, wind tunnels, environmental chambers, and storage tanks at many worldwide locations, including Hanford.

Name: Robert R. Roberts

Position: Facility Engineering Subpanel Leader

Education: B.S., Geology/Chem, Colorado State University, 1967
M.S., Met . Engineering, Colorado School of Mines, 1971
M.B.A., Finance, San Diego State University, 1988

Affiliation: Senior Project Manager, Process Hazards Management Division
Science Applications International Corp.

Experience: Mr. Roberts has 15 years of industrial experience with fortune 500 companies in petroleum production, refining, mining, and metals production and refining. Mr. Roberts has five years of experience providing consulting services to private industry in risk management, hazards identification, process safety management, and regulatory compliance. Mr. Roberts consulted for Roberts Associates and NUS Corporation prior to joining SAIC.

Name: Boris I. Rosev

Position: Facility Engineering Subpanel Member

Education: M.S. Electrical & Mechanical Engineering University in Europe, (6 Year Course), Electric Power Engineering in Nuclear and Fossil Power Plants Specialty. Graduated in July, 1967. The Degree was evaluated and accepted by Columbia University of NY., in March 1970.

Affiliation: Los Alamos National Laboratory

Experience: Mr. Rosev has 25 Years as:
Power Plant Design and Support Engineer: Extensive design experience with Nuclear and Fossil Power Plants including designing and managing complex engineering projects; developing and reviewing requirements, project proposals, expenditure requests and schedules; coordinating maintenance and construction work forces. Project Engineer: Experience with design, installation and commissioning of Nuclear and Fossil Power Plants including coordinating and supervising contractors on assigned engineering tasks; preparing project construction schedules and cost estimates; and installing and commissioning large power components in Nuclear and Fossil Power Plants.

Name: Anthony Rutz

Position: Regulatory Requirements Subpanel Member

Education: B.S., Biological Sciences, Michigan State University, 1969.
M.P.H., Environmental Health, University of Michigan, 1973.
Ph.D. course work completed, University of Michigan

Affiliation: Consultant, Wastren, Inc.

Experience: Mr. Rutz manages Wastren's technical support functions for the DOE Idaho Operations Office, including the INEL Site-Wide Waste Management Environmental Impact Statement, a Plutonium Recovery demonstration project, regulatory compliance road maps and strategic plans, and several ES&H training programs. He supported the completion of the WIPP Supplemental EIS< and is working toward closure on the LANL implementation of DOE Order 5820.2A for waste management and RCRA compliance activities, and Waste Minimization Plans for the INEL and West Valley Demonstration Project.

Name: Richard A. Stephans

Position: Process Engineering Subpanel

Education: B.S., Ch.E., Purdue University, 1957; M.S., M.E., NM State Univ. 1964; Command and Gen. Staff Coll. U.S. Army, 1969; Air War Coll. U.S. Air Force, 1974; Indust. Coll. Armed Forces, 1979

Affiliation: Ogden Environmental and Energy Services

Experience: Mr. Stephans has 28 years experience in evaluating and in managing nuclear, chemical, and environmental programs. He supervised ordnance, chemical, safety, quality assurance, and logistics personnel, and managed a chemical plant, specializing in advanced planning for quality assurance operations, and performed nuclear and other quality audits. He is an expert in environmental analysis and pollution control, trained in hazardous waste disposal. He performed impact assessments, prepared impact statements, conducted safety analyses, and knows the requirements of the EPA, FEMA, NRC, OSHA, DOD, DOT (nuclear requirements), and DOE. He is an explosives and munitions expert technically trained in ordnance munitions, with hands-on experience with a variety of conventional, chemical, and nuclear devices.

Name: Steven M. Thornberg

Position: Phenomenology Subpanel Member

Education: B.A., Chemistry and Mathematics, Western State College, 1980 Ph.D., Analytical Chemistry, University of New Mexico

Affiliation: Sandia National Laboratories

Experience: Dr. Thornberg first worked for the Primary Standards Laboratory, becoming the project leader in the Pressure/Vacuum/Leak Calibration Laboratory and providing calibration standards for the DOE/AL weapons complex. He participated in numerous technical and quality audits of contractor standards laboratories throughout the complex. He then transferred to the Chemistry Department in the Organic and Inorganic Gas Analysis Laboratory (GC, GC/MS, MS, ITMS), supporting numerous programs within SNL. He initiated environmental studies and field analysis of volatile organic compounds to support hazardous-waste-site remediation efforts.

Name: William M. Thompson

Position: Process Engineering Subpanel Member

Education: Ph.D., Electrical Engineering

Affiliation: Nuclear Systems Associates, Inc., (NSA), Brea, CA

Experience: Mr. Thompson has 40 years experience in research, development, design, and analysis of equipment, systems, and facilities for nuclear fuel and waste handling, processing, and retrieval. At NSA he as been involved mainly with remote handling, robotic, and manipulation systems, including design and studies for a prototype waste retrieval system for Hanford SSTs, a front-end modification to the PUREX plant at Hanford, and an advanced fuel reprocessing facility at ORNL. At ANL, he was involved with the designs and development of master-slave servo-manipulators, and the fuel handling system and instrumented fuel assemblies for the EBR-II sodium-cooled reactor. He was on the review committee for safety aspects of all plant modifications to EBR-II. He also served on a special committee for reviewing the reactor shutdown system for the FFFTF reactor at Hanford.

Name: Philip Thullen

Position: Team Consultant

Education: B.S. ME, Purdue University, 1965; M.S. ME, MIT, 1967
Sc.D., MIT, 1969

Affiliation: LANL, N-DO/RT

Education: Dr. Thullen was an Associate Professor of Mechanical Engineering at MIT. As a member of the thermal and fluid sciences division, he researched the application of superconductors to electrical power equipment while teaching thermodynamics, cryogenic engineering, and related subjects. As a LANL staff member, he served as Deputy Group Leader and Program Manager in energy-related fields, continuing his work on superconductivity and design of electromagnetic systems for plasma fusion applications. He was the Program Manager for Construction of the Confinement Physics Research Facility (1985 to 1991), an $80M, 7-yr construction project employing 70 FTEs, giving him in-depth experience in applied research and in the organization and management of R&D facility construction.

Name: Douglas Weaver

Position: Team Consultant

Education: BSET, DeVry Tech. Institute, 1966

Affiliation: Sandia National Laboratory

Experience: Since 1967 Mr Weaver has worked at SNLaboratory where he held a number of technical and supervisory positions. From 1984 to 1986, he was superviser of the Radiation Hardened Integrated Circuit II Development Division, responsible for developing the microelectronics technology and process clean room, and facility concepts for the 167 000 sq. ft., $67M RHIC II facility. He then became the Department Manager of Microelectronics Component Development, including technology and process development, prototyping, DOD and industry reimbursable projects, and advanced microelectronics packaging development. He has been responsible for the activities of over 100 Ph.D, M.S., and B.S. engineers, technicians, and hourly personnel, with an annual budget of $15m.

APPENDIX K

LIST OF ACRONYMS

AAMSR	Aggregate Area Management Study Report
ADS	Activity Data Sheet
AEU	Analytical Equivalent Unit
Al	aluminum
ALARA	as low as reasonably achievable
ASME	American Society of Mechanical Engineers
AWF	Aging Waste Facility
CAD	computer assisted design
CASS	computer automated surveillance system
CC	complexant concentrate
CDR	Conceptual Design Report
CE	Cognizant Engineer
CERCLA	Comprehensive Environmental Response, Compensation and Liability Act
CERT	constant extension rate tensile test
Ci	Curies
COO	conduct of operations
CPS	Criticality Prevention Specification
Cr	chromium
Cs	cesium
CSEIS	Comprehensive Supplemental Environmental Impact Statement
CTMS	Continuous Temperature Monitoring System
CY	calendar year
D&D	decommissioning and decontamination
DNFSB	Defense Nuclear Facilities Safety Board
DOE	U.S. Department of Energy
DOE-EM	U.S. Department of Energy-Office of Environmental Restoration and Waste Management
DOE-HQ	U.S. Department of Energy Headquarters
DOE-RL	U.S. Department of Energy - Richland Operations
DQO	data quality objectives
DSS	double-shell slurry
DSSF	double-shell slurry feed
DST	double-shell tank
ECN	Engineering Change Notice
EDE	effective dose equivalent
EDTA	ethylenediaminetetraacetic acid (chelating agent)
EIS	Environmental Impact Statement
EM	USDOE Office of Environmental Restoration and Waste Management
EPA	Environmental Protection Agency

ES&H	Environmental Safety and Health
ES&Q	Environmental Safety and Quality
FDC	functional design criteria
FEMPS	Facility Effluent Monitoring Plans
FFACO	Federal Facility Agreement and Consent Order
FFCA	Federal Facility Compliance Agreements
FFTF	Fast Flux Test Facility
FIC	Food Instrument Corporation of America
FSAR	Final Safety Analysis Report
FY	fiscal year
GAO	General Accounting Office
HEHF	Hanford Environmental and Health Foundation
HEPA	High-efficiency Particle Filter
HFFACO	Hanford Federal Facility Agreement and Consent Order
HLW	high-level waste
HQ	headquarters
HTFO	Hanford Tank Farm Operations
HP	Health Physics or Health Physicist
HWVP	Hanford Waste Vitrification Project
HWVS	Hanford Tank Waste Vitrification System
HVAC	Heating, Ventilation, Air Conditioning
ICP	inductively coupled plasma
INPO	Institute of Nuclear Power Operations
ITR	Independent Technical Review/independent technical review
JCS	Job Control System
KEH	Kaiser Engineers Hanford
LANL	Los Alamos National Laboratory
LDR	Land Disposal Restriction
LEL	lower explosion limit
LERF	Liquid Effluent Retention Facility
LETF	Liquid Effluent Treatment Facility
LFL	lower flammability limit
LIMS	Laboratory Information System
LLW	low-level waste
LOW	liquid observation well
MCi	megacurie (10^6 curies)
NCAW	neutralized current acid waste
nCi	nanocurie (10^{-9} curies)
NCO	NEPA Compliance Officer
NDT	nil-ductility-transition
NEPA	National Environmental Policy Act
NESHAPS	National Emission Standards for Hazardous Air Pollutants
NH_3	ammonia gas
Ni	nickel
NOD	Notice of Deficiency
NPO	Nuclear Power Operations

NRC	U.S. Nuclear Regulatory Commission
OSD	Operational Specification Document
ORP	Occurrence Reporting Program
OSHA	Occupational Safety and Health Administration
OSR	Operational Safety Requirement
PC	personal computer
PFP	Plutonium Finishing Plant
PIC	Person-In-Charge
PNL	Pacific Northwest Laboratory
PUREX	Plutonium-Uranium Extraction (Plant)
QA/QC	Quality Assurance/Quality Control
R&D	research and development
RCRA	Resource Conservation and Recovery Act
rem	Roentgen Equivalent Man (1 roentgen)
SACS	Surveillance Analysis Computer System
SAR	Safety Analysis Report
SCE	saturated calomel electrode
SRS	Savannah River site
SST	single-shell tank
S&W	Stone and Webster
STREX	strontium extraction process
TCLP	toxicity characteristic leaching procedure
TMACS	tank monitoring and system control
TOC	total organic carbon
TOSB	Technical Oversight Board
TPA	Tri-Party Agreement
TRAC	Tracks the RAdioactive Components
TRU	Transuranic
TRUEX	Transuranic Extraction
TTX	time to explosion
TWRS	Tank Waste Remediation System
U	uranium
UOR	Unusual Occurrence Report
UORP	Unusual Occurrence Reporting Procedure
USQ	Unreviewed Safety Questions
VOC	volatile organic compounds
WDOE	Washington State Department of Ecology
WHC	Westinghouse Hanford Company
WVRF	waste volume reduction factor
Zr	zirconium