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WHC-EP-0533

Integrated Sampling and Analysis Plan

For Samples Measuring >10 mrem/hour

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

Westinghouse
Hanford Company Richland, Washington

Hanford Operations and Engineering Contractor for the
U.S. Department of Energy under Contract DE-AC06-87RL10930

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Document Title: Integrated Sampling and Analysis Plan for Samples Measuring >10 mrem/hour

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EXECUTIVE SUMMARY

This integrated sampling and analysis plan was prepared to assist in planning and scheduling of Hanford Site sampling and analytical activities for all waste characterization samples that measure greater than 10 mrem/hour. This report also satisfies the requirements of the renegotiated Interim Milestone M-10-05 of the *Hanford Federal Facility Agreement and Consent Order** (the Tri-Party Agreement).

In September 1991, Milestone M-10-05 was approved as "Issue Integrated Plan, Sampling and Analysis of Hanford Site Waste Measuring Greater Than 10 mrem Per Hour." The scope of the change request is as follows:

> *"The letter transmitting the plan to Ecology will include the USDOE recommended plan of action. The scope of the plan will include: (1) identification of current and projected sampling and analysis needs for Hanford Site wastes measuring greater than 10 mrem per hour; (2) assessment of existing and planned resources; (3) establishment of prioritization criteria; (4) development of an integrated schedule; (5) analysis of the integrated schedule and plan to determine actions necessary to meet and support Milestone M-10-00; and (6) identification of opportunities for acceleration. In this plan the sampling and analysis strategy and*

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*Ecology, EPA, and DOE, 1990, *Hanford Federal Facility Agreement and Consent Order*, Vols 1 and 2, Washington State Department of Ecology, U.S. Environmental Protection Agency, and U.S. Department of Energy, Olympia, Washington.

redefinition of interim milestones required to satisfy Milestone M-10-00 will be accomplished and the projected near-term sampling events identified. This plan will be the basis for a change request to interim Milestones M-10-07 through M-10-12 showing how missed cores will be recovered before September 1998. The target date for release of the draft document to Ecology is January 31, 1992."

Of the current 31 major Tri-Party Agreement milestones, 5 are complete, 4 are not related to Hanford Site analytical capabilities, and 22 will be affected by the Hanford Site analytical laboratory throughput capacity.

Greater than 10 mrem/hour samples are defined as "characterization samples" with expected surface dose rates in excess of 10 mrem/hour. Programs that were included in the assessment of "current and projected sampling and analytical needs" are as follows:

- Single-shell tank (SST) waste characterization
- Waste tank safety issue resolution (assumes waste characterization analyses are performed on same samples as safety resolution analyses)
- 242-A Evaporator feed characterization
- Grout feed characterization

- Grout vault core sampling
- N and K Basin sludge characterization and cleanout
- Soil remediation programs
- SST interim stabilization and isolation
- Hanford Waste Vitrification Plant technology development
- Solid Waste Characterization and Waste Receiving and Packaging process development.

Other Hanford Site programs that can generate >10 mrem/hour samples were considered but not included in the projected sampling and analysis needs section of this report because these programs are projected to require a relatively small portion of the total Hanford Site analytical capacity through 1998. These programs include, cleanout of the Plutonium-Uranium Extraction Facility, B Plant cleanout, Fast Flux Test Facility fuel examination, decontamination and decommissioning projects, Pacific Northwest Laboratory (PNL) Research and Development activities, and PNL hot cell cleanout. Additionally, the large volume of alpha sample preparation and analysis required to support the Solid Waste Characterization and Waste Receiving and Packaging activities was not included because the analytical work is not planned to be performed in any of the existing Hanford Site analytical facilities.

For purposes of comparing the various analytical needs with the Hanford Site laboratory capabilities, the analytical requirements of the various programs were normalized by converting required laboratory effort for each type of sample to a common unit of work, the standard analytical equivalency unit (AEU). The AEU approximates the amount of laboratory resources required to perform an extensive suite of analyses on five core segments individually plus one additional suite of analyses on a composite sample derived from a mixture of the five core segments and prepare a validated RCRA-type data package.

As indicated in this plan, acceleration of activities that increase the annual throughput in the Hanford Site laboratories for samples measuring >10 mrem/hour is required to meet future demands. Westinghouse Hanford Company planning will address fast-track implementation of laboratory upgrades in support of Hanford Site analytical requirements.

The necessary laboratory upgrades described in this plan increase the laboratory analytical capacity sufficiently to complete single-shell tank characterization Milestone M-10-00 in 1998.

The Secretary of Energy has committed to accelerate the Hanford Site programs if possible, completing the sampling and analytical programs ahead of schedule. Options for this acceleration are summarized in the report.

As more information about the wastes stored at the Hanford Site becomes available, the analytical projections, schedules, and priorities will change;

therefore, a schedule will be established to re-evaluate the conclusions derived in this report. The report will be revised accordingly.

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INTEGRATED SAMPLING AND ANALYSIS PLAN FOR SAMPLES MEASURING >10 MREM/HOUR

1.0 CURRENT AND PROJECTED SAMPLING AND ANALYSIS NEEDS

1.1 THE ANALYTICAL EQUIVALENCY APPROACH

To facilitate evaluation of analytical capacity (laboratory "throughput"), the diverse resource requirements for each program must be normalized into equivalent units. In this way, the work load associated with all >10 mrem/hour samples can be quantified in comparable units, and the capacities of the programs to handle this load can be determined for different cases.

1.1.1 Standard Analytical Equivalency Unit

The standard analytical equivalency unit (AEU) is the unit of work established as the baseline for evaluating the analytical needs of Hanford Site programs. The AEU is defined as the analytical burden required to perform the full suite of analyses identified in Tables I5-1 and I5-2 of the *Waste Characterization Plan for the Hanford Site Single-Shell Tanks* (WHC 1991b) on each segment and one core composite of a typical five-segment waste tank core sample and to report the results in a validated RCRA-type data package within 180 days of the date the last segment of the core sample is taken. The amount of resources required to accomplish this work has a value of 1.0 AEU.

1.1.2 Analytical Equivalency Unit Factor

A factor is estimated to relate the analytical work required for each program to the standard AEU. Multiplying this factor by the total number of samples yields an estimate of the total analytical work load for a program in AEUs.

1.1.3 Examples

For example, the sampling and analysis program for N and K Basin sludge samples is estimated to require only about 20% of the laboratory effort as the standard analytical unit; therefore, a factor of 0.2 is assigned to these samples. Multiplying the number of samples times the factor yields 18 AEU for the N and K Basin program (90 samples x 0.2 AEU/sample).

The laboratory throughput can likewise be stated in AEU per year by evaluating past performance and throughput estimates from the laboratory management personnel from Westinghouse Hanford and Pacific Northwest Laboratory (PNL). Once the analytical throughput is established in AEUs, schedule and completion dates can be projected. Acceleration options can also be evaluated in terms of additional throughput, allowing schedule improvements to be readily determined.

1.2 ANALYTICAL EQUIVALENCY DERIVATIONS FOR EACH PROGRAM

1.2.1 Standard Analytical Equivalency Unit

The application of the AEU approach to "normalizing" the >10 mrem/hour analytical needs requires that a reasonably well established analytical support program be designated as the standard case against which all other analytical support programs are compared. The standard case chosen for this report is the "standard" single-shell tank (SST) core sample analysis program. This program was chosen because both the 222-S Laboratory and the PNL Analytical Chemistry Laboratory have experience in performing this analysis program and have determined their capacities for annual throughput based on this experience. Currently, each lab can handle 12 standard SST core samples per year, i.e., 12 AEU.

The SST core analysis program consists of five major activities. These activities and their estimated relative levels of effort in fractions of a standard AEU are shown below. Table 1-1 presents a similar breakdown for each program generating >10 mrem/hour samples. The estimates are based on the judgement of the authors with input from the various program and laboratory personnel.

- Core sample receipt and preparation = 0.1 AEU
- Physical properties determinations = 0.1 AEU
- Composite preparation and assay = 0.1 AEU
- Segment preparation and assay (five segments at 0.1 AEU each) = 0.5 AEU
- Report preparation = 0.2 AEU
- Total (standard AEU) = 1.0 AEU

Table 1-1. Standard Analytical Equivalency Unit Factors.

Sample	Receipt and preparation	Physical properties determination	Composite assay	Segment assay	Other assay	Report preparation	AEU factor
Standard AEU core	0.1	0.1	0.1	0.5	None	0.2	1.0
Nonwatchlist SST core	0.1	0.1	0.2	None	None	0.2	0.6
Watchlist SST core	0.1	0.1	0.1	0.5	0.1	0.2	1.1
Watchlist DST core	0.2	0.2	0.2	1.1	0.4	0.2	2.3
242-A Evaporator feed	0.05	0.05	0.2	N/A	0.1	0.03	0.4
Grout feed	0.05	None	0.2	N/A	0.2	0.2	0.6
Grout vault core	0.05	0.05	None	0.05	None	0.05	0.2
DST core	0.1	0.1	0.1	0.15	0.05	0.1	0.6
DST dip sample	0.02	None	None	N/A	0.05	0.03	0.1
N and K Basin sludge	0.05	None	None	None	0.05	0.1	0.2
Soil samples	0.01	N/A	N/A	N/A	0.03	0.06	0.1
Interim stabilization and isolation	0.05	None	None	N/A	0.10	0.05	0.2
Waste Receiving and Packaging	0.02	0.01	N/A	N/A	0.04	0.03	0.1
Waste tank remediation development	0.1	0.1	0.2	None	None	0.2	0.6
Solid waste characterization	0.01	0.01	N/A	N/A	0.04	0.04	0.1
Retest cores	0.05	None	None	N/A	0.2	0.15	0.4

*AEU factors are rounded to the nearest tenth.
AEU = Analytical equivalency unit.
DST = Double-shell tank.
SST = Single-shell tank.

1.2.2 Core Sample Analysis Program for Safety Watchlist Single-Shell Tanks

Forty-seven SSTs have been placed on the Safety Watchlist because of concerns with hydrogen generation, ferrocyanide content, and/or organic content. A minimum of two core samples, consisting of an average of five segments, will be taken from these tanks. These core samples are assumed to be analyzed according to the analysis scenario defined for SSTs C-109 and C-112 in the *Waste Characterization Plan for the Hanford Site Single-Shell Tanks* (WHC 1991b).

The receipt and preparation of the watchlist core samples, physical properties determination, and the composite assays are identical to the standard AEU core. However, to enhance the resolution of the vertical distribution of key analytes, a limited suite of analysis will be performed on each subsegment of watchlist cores. This limited suite of analysis is roughly one-quarter (or 0.05 AEU) of the analytical burden of the full suite of

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analyses in a standard AEU segment.* Therefore, the additional analytical burden of performing the subsegment assays on watchlist tanks is 0.5 AEU.** In addition, incremental analyses (adiabatic calorimetry, FeCN specification, etc.) are performed specifically to address the safety concerns associated with a particular watchlist tank. The analytical burden of these other assays is estimated at 0.1 AEU per core. The reporting requirements of the watchlist core samples is identical to the standard AEU core. Thus, the overall AEU factor for watchlist SSTs is 1.1.

1.2.3 Core Sample Analysis Program for Nonwatchlist Single-Shell Tanks

The program for nonwatchlist SSTs, which is also defined in the *Waste Characterization Plan for the Hanford Site Single-Shell Tanks* (WHC 1991b), is identical to that for the first core of the watchlist tanks with an overall AEU factor of 0.6. It is assumed that DST cores will be analyzed in the same manner.

1.2.4 Core Sample Analysis Program for Watchlist Double-Shell Tanks

The watchlist double-shell tanks (DST) do not average well with the general waste tank population because of the large number of segments required and the additional information expected to be requested by the laboratory as more is learned about the waste in these tanks. An overall AEU factor of 2.3 is assigned to DST watchlist tanks based on experience to date and broken down in Table 1-1.

1.2.5 Double-Shell Tank Dip Sample Analysis for Evaporator Feed, Grout Feed, and Technology Development

Samples of the liquid wastes (dip samples) are taken to determine characterizations mandated by the *Resource Conservation and Recovery Act of 1976* (RCRA) and to support a variety of technology development programs. These sample programs are described in the *Grout Sampling Plan* (WHC 1991c), *Double-Shell Tank System Dangerous Waste Permit Application* (DOE 1991a), and 242-A Evaporator dangerous waste permit applications (DOE 1987; 1991b). The analysis plans in these documents indicate that about 16 different determinations will be required for the dip sample assays, as compared to about 36 for the standard segment assay for a core sample. The AEU factor for the dip sample assays was therefore set at 0.05, about one-half of that for a core segment assay. Additionally, the receipt and preparation of the dip samples is expected to be significantly easier than for core samples; therefore, this activity was rated at only 0.05 AEU. The reporting effort for these samples is nearly negligible compared to the other reporting efforts. An overall AEU factor of 0.1 results.

---

*1.0 AEU ÷ 5 segments ÷ 4 = 0.05 AEU per subsegment.

**10 subsegments x 0.05 AEU per subsegment = 0.5 AEU.

1.2.6 N and K Basin Sludge Cleanout Samples

Samples of the sludges from the N and K Fuel Storage Basins will be analyzed for RCRA characterization and process development. The sampling program for the N Basins (105-N and 107-N) are defined in the *N Basin Task - Sampling and Analysis Plan* (WHC 1990). It is assumed that a similar program would apply to the K-East Basin. Forty-five samples will be taken from each area, for a total of 90 samples.

The sludge samples have a high dose rate that will make them equivalent to the DST dip samples for receipt and preparation, 0.05 AEU. Also, the analyses planned for these samples are similar in extent to those for the dip samples from the DSTs, 0.05 AEU. The report preparation for these samples requires more effort than the DST dip samples and is estimated to be about half that of the standard AEU core, 0.1 AEU. Therefore, an overall AEU factor of 0.2 is assumed.

1.2.7 Soil Samples

Sampling of soils from boreholes will be done in the operable unit areas defined for the Hanford Site in the *Hanford Federal Facility Agreement and Consent Order* (the Tri-Party Agreement) (Ecology et al. 1990). These sampling and analysis programs are defined in operable unit work plans such as *Remedial Investigation/Feasibility Study Work Plan for the 100-BC-5 Operable Unit, Hanford Site, Richland, Washington* (DOE 1990). Continuous soil samples will be taken and analyzed to establish contaminant concentrations and boundaries from spills and planned releases. Although these samples exceed 10 mrem/hour, few are expected to be excessively "hot"; therefore, a receipt AEU factor of only 0.01 is estimated. The number of analyses is projected to be limited for most of the samples, hence the 0.03 AEU factor for assay and 0.06 AEU factor for reporting. An overall AEU factor of 0.1 results.

1.2.8 Hanford Waste Vitrification Plant Technology Development

Samples to support the Hanford Waste Vitrification Plant (HWVP) are divided into two categories, liquid dip samples and solid core samples. The liquid dip samples are estimated to require the same effort as the evaporator feed and grout feed dip samples, 0.1 AEU. The solid core samples for HWVP are projected to be similar to a nonwatchlist SST, 0.6 AEU. In Tables 1-1 and 1-2, HWVP is included under nonwatchlist DST liquid and solid samples.

1.2.9 Interim Stabilization and Isolation

Samples to support process compatibility and regulatory requirements require a set of analytical determinations similar to that of an SST core, hence the 0.10 AEU factor for assay. Reporting is similar to, but less rigorous than the SST core; thus the 0.05 AEU factor for reporting. Adding 0.05 for dip sample preparation results in an overall AEU factor of 0.2.

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1.2.10 Solid Waste Characterization and Waste Receiving and Packaging

These waste samples will come to the laboratory in various forms requiring a variety of sample preparation techniques with a mix of hot cell requirements similar to the soil samples. The analytical load estimated for this report supports the up-front effort to define the follow-on needs for the solid waste and does not include extensive alpha laboratory work in the program plans for actual waste treatment and disposal. Averaging the difficulty in dealing with what is expected to be the majority of this waste type, an AEU factor of 0.1 is estimated.

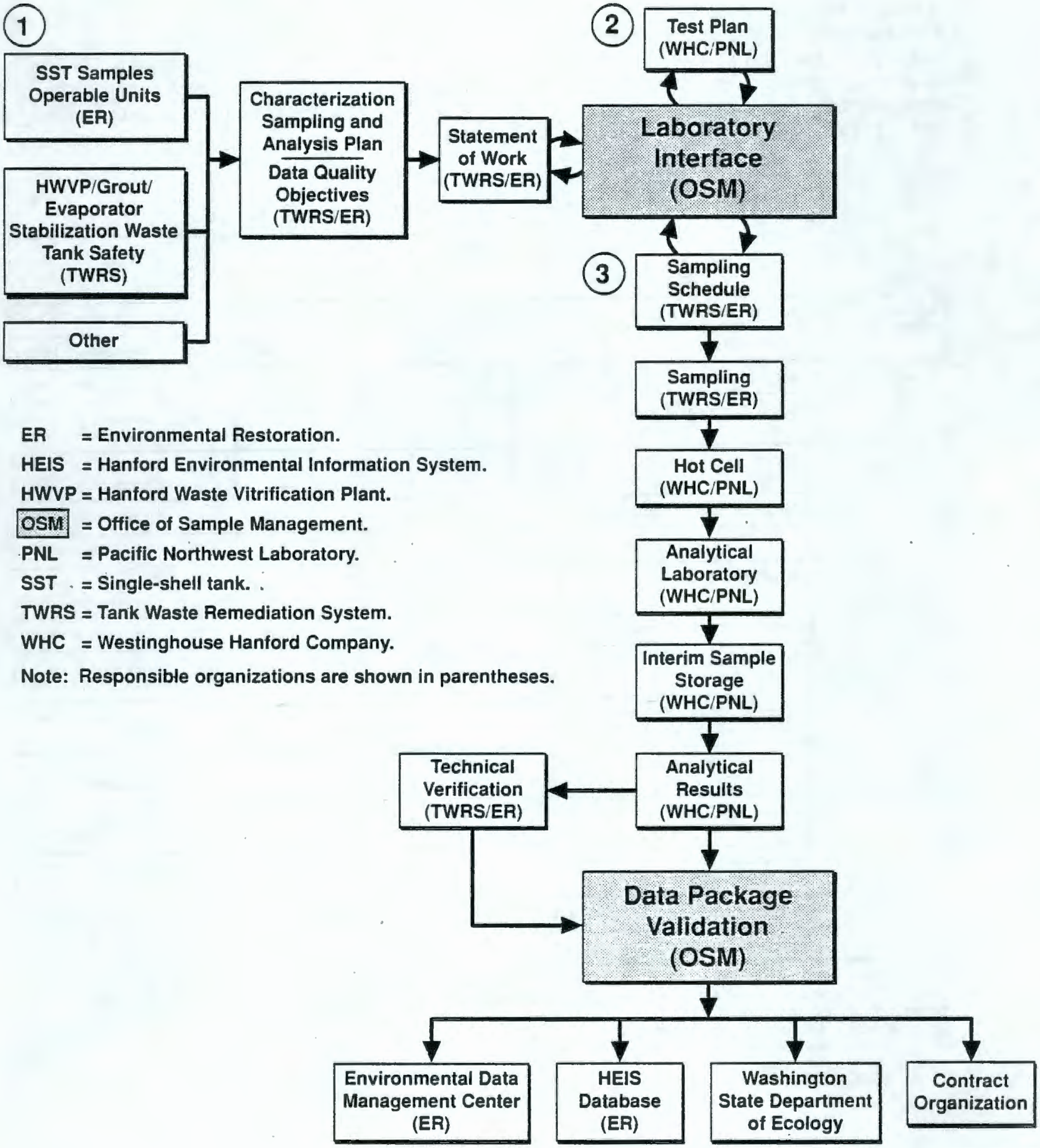
1.2.11 Waste Tank Remediation

Samples to support process selection and remediation of waste tanks will be treated as similar to SST cores until more program definition is available.

1.2.12 Retest Cores (estimated)

All programs are experiencing a limited amount of unplanned sample activity for various safety and technical reasons. The assay is usually specific in nature and similar in other respects to an interim stabilization and isolation sample; thus an AEU factor of 0.4 was assigned.

1.3 SAMPLE PROCESSING FLOWCHART



ER = Environmental Restoration.
HEIS = Hanford Environmental Information System.
HWVP = Hanford Waste Vitrification Plant.
OSM = Office of Sample Management.
PNL = Pacific Northwest Laboratory.
SST = Single-shell tank.
TWRS = Tank Waste Remediation System.
WHC = Westinghouse Hanford Company.
Note: Responsible organizations are shown in parentheses.

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1.4 PROJECTED PROGRAM ANALYTICAL NEEDS

Table 1-2 summarizes the >10 mrem/hour sample and analytical needs through September 1998. The bases for numbers of tanks (batches) and cores or samples are provided in Appendix B. A matrix identifying overlapping waste tank (SST and DST) analytical requirements is maintained by the Waste Tank Characterization Program to take full advantage of all work associated with each waste tank sample. This matrix was applied to the projected program analytical needs listed in Table 1-2.

Table 1-2. Projected Program Analytical Needs.

			Tanks (batches)	Cores (samples) per tank	Total cores (samples)	AEU factor	AEU total	Target completion
Single-shell tanks	Watchlist tanks		47*	2	94	1.1	103	September 1996
	Other SSTs		102	2	204	0.6	122	September 1998
Double-shell tanks	Watchlist tanks		5	2	10	2.3	23	September 1996
	242-A Evaporator feed		14	(12)	(168)	0.1	17	Beyond September 1998
	Grout feed		(13)	(10)	(130)	0.1	13	Beyond September 1998
	Nonwatchlist double-shell tanks	Solids	10	4	40	0.6	24	September 1997
		Liquid	10	(15)	(150)	0.1	15	September 1997
Other samples measuring >10 mrem/hour	Grout vault cores		13	3	39	0.2	8	Beyond September 1998
	N and K Basin sludge		(N/A)	(90)	(90)	0.2	18	September 1996
	Soil remediation		(600)	N/A	(600)	0.1	60	Beyond September 1998
	Interim stabilization and isolation		30	(2)	(60)	0.2	12	September 1995
	Waste Receiving and Packaging		(100)	N/A	(100)	0.1	10	Beyond September 1998
	Waste tank remediation		60	N/A	60	0.6	36	Beyond September 1998
	Solid waste characterization		(100)	N/A	(100)	0.1	10	September 1996
	Retest cores (est.)		N/A	N/A	30	0.4	12	September 1998
Total							483	

*One tank, a high-heat watchlist SST, has been moved from the Watchlist tank totals here to the Other SSTs category because of the similarity between sampling and analysis for that tank and other nonwatchlist SSTs.

AEU = Analytical equivalency unit.
HWVP = Hanford Waste Vitrification Plant.
N/A = Not applicable.
SST = Single-shell tank.

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2.0 ASSESSMENT OF EXISTING AND PLANNED RESOURCES

2.1 ANALYTICAL LABORATORIES

Currently, four analytical laboratories in operation on the Hanford Site are capable of analyzing radioactive samples with dose rates >10 mrem/hour: the Plutonium-Uranium Extraction Facility (PUREX), the Plutonium Finishing Plant (PFP), the 222-S Laboratory, and the PNL Analytical Chemistry Laboratory. These facilities are described in Appendix C. The PUREX laboratory is dedicated to process control and other analyses in support of operating the PUREX plant; however, since termination of processing in mid-1990, the PUREX laboratory has had limited work and currently operates on a day-shift-only schedule. The PFP laboratory will be dedicated to support the PFP stabilization and cleanout program through 1995.

The >10 mrem/hour sampling needs identified in the report are currently provided exclusively by the 222-S Laboratory and the PNL Analytical Chemistry Laboratory. The combined throughput capacity of the 222-S Laboratory and the PNL Analytical Chemistry Laboratory through fiscal year (FY) 1998, based on planned resources, is 364 AEU (199 and 165 AEU respectively).

These throughput projections are based on implementation of an aggressive Hanford Site Analytical Laboratory Upgrade Program, as described in Table 2-1. A breakdown of the analytical capacity for each laboratory is presented graphically in Figure 2-1.

Three hundred sixty-four AEU is not sufficient to support projected program analytical needs as presented in Table 1-2, and a more aggressive analytical laboratory upgrade schedule, described in Section 5, has been developed to support successful completion of the Hanford Site characterization requirements. Change Control Requests have been prepared for FY 1992. Budget modification submittals are being developed for FY 1993 and FY 1994 to support the fast-track implementation of laboratory upgrades as shown in Table 5-1.

Table 2-1. Planned Laboratory Upgrades.

PNL Analytical Chemistry Laboratory

Upgrades	Planned implementation
Facility upgrades	
B-Hot Cell renovation	September 1993
Sample Receiving Facility	September 1993
Standards Laboratory	September 1994
Radiochemistry Laboratories	Ongoing. Completed by September 1997
Inorganic Laboratories	Ongoing. Completed by September 1997
Instrumentation upgrades	Ongoing. Completed by September 1997
A-Hot Cell cleanout	September 1996
Increase analytical staffing	
B-Hot Cell staff (second shift)	Not planned before 1998
Data review and data package preparation (double staff size)	Not planned before 1998
Full Laboratory Information Management System (LIMS)	September 1995

222-S Laboratory

Upgrades	Planned implementation
Interim laboratory information management system	September 1992
PQ shift	August 1993
Second inductively coupled plasma unit	September 1992
Full laboratory information management system (LIMS)	June 1995
Staff to 7 days/week, 10 hours/day	June 1995
New hot cell startup (HVAC and electrical upgrades)	June 1996

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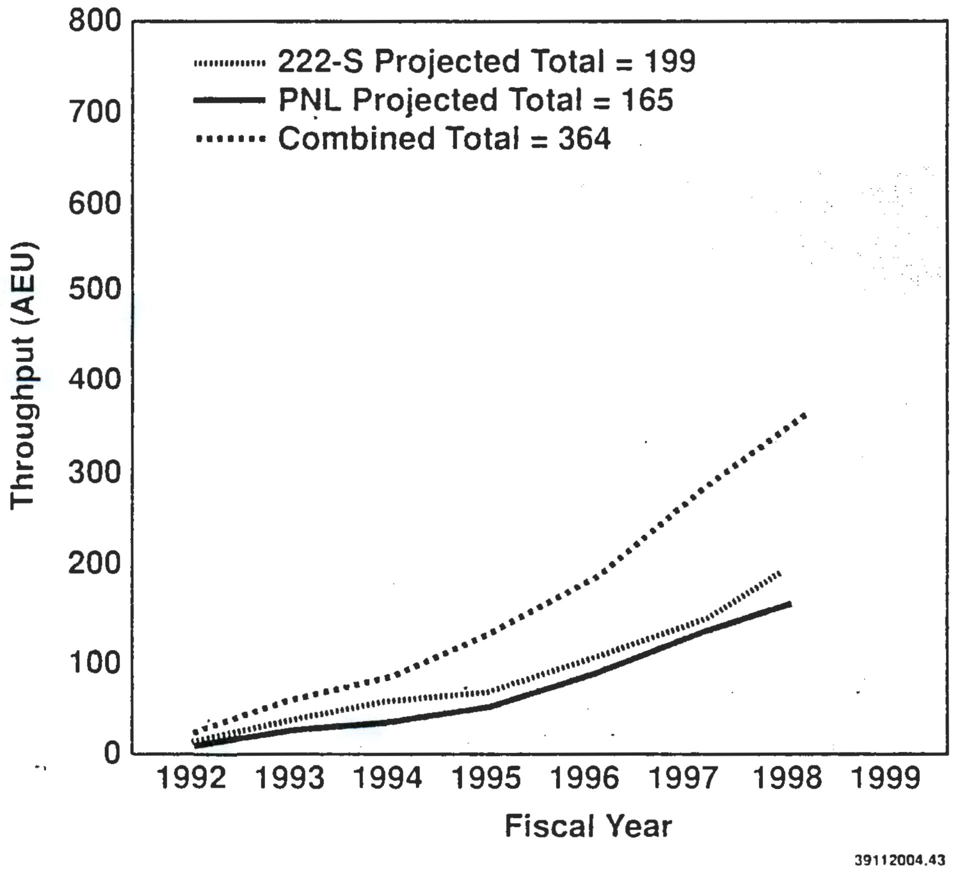
Figure 2-1. Cumulative Analytical Laboratory Throughput Based on Planned Resources.



2.2 WASTE TANK CORE SAMPLING

Presently, one crew with one sample truck can collect 30 cores per year.

Planned and funded program upgrades include the addition of a second sampling crew for the existing sample truck and a second sample truck. The second crew will be trained by October 1992. The truck, now in production, is scheduled for completion in October 1992.

With the availability of the second crew and the second truck, sampling capabilities should more than double in early 1993. The addition of a third sampling crew and dedicated support personnel is planned for 1994 and will add an additional 40 cores per year.

Implementation of these planned upgrades as scheduled will meet both short- and long-term core sampling requirements.

The uncertainties in waste tank core sampling primarily focus on the open safety issue surrounding hard salt cake drilling. Hard salt cake sampling issues are scheduled to be resolved in 1993. If resolved on schedule, this will support the sampling schedule.

3.0 PRIORITIZATION CRITERIA

The priorities for all Hanford Site activities, including sampling and analysis programs, are listed below.

- Priority A--Safe Operations
- Priority B--Compliance (not covered above)
- Priority C--Safety Assurance (not covered above)
- Priority D--Compliance Assurance (not covered above)
- Priority E--Conduct of Operations (not covered above)
- Priority F--Enhanced Operations.

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3.1 HANFORD SITE PRIORITIES FOR THE WASTE MANAGEMENT PROGRAM

3.1.1 Priority A. Safe Operations

A1. Work toward resolution of unresolved and imminent safety issues through characterization, analysis, mitigation, and remediation efforts (i.e., Watchlist high-level waste storage tanks).

A2. Maintain safe facility configuration defined as follows:

- Developing or revising safety analysis reports (as necessary)
- Operating and maintaining safety related equipment/systems required by Operational Safety Requirements to include such items as: alarms, ventilation, electrical, and fire protection. The work includes corrective actions to respond to problems identified (i.e., repair or upgrades). This is related to equipment which is needed to maintain key facilities in a safe configuration (i.e., not all alarms onsite)
- Maintaining key infrastructure facilities which directly relate to safe facility configurations (i.e., steam and laboratory support)
- Maintaining adequate tank capacity and support operations, (i.e., operation of the evaporator)
- Stabilizing the PFP and UO_3 Plants.

3.1.2 Priority B. Compliance (not covered above)

B1. Ensure compliance with environmental laws and the Tri-Party Agreement.

Efforts include

- Regulatory interpretation
- Monitoring and reporting
- Permitting, as required by RCRA, *Clean Air Act*, the *Clean Water Act*, and/or the *Toxic Substances Control Act*
- Tank and other assessments
- On-time milestone completion.

B2. Pursue corrective actions that deal with compliance issues:

- Upgrade facilities (i.e., stop effluent flow or provide treatment of effluent)
- Operate to stay in compliance, (i.e., ensure that 90-day storage provisions of hazardous waste are adhered to).

3.1.3 Priority C. Safety Assurance (not covered above)

C1. Enhance public safety through the following:

- Monitoring radioactive and hazardous operations for air and water emissions
- Providing emergency preparedness capability in order to respond to events.

C2. Enhance worker safety through efforts related to

- Compliance with the Occupational Safety and Health Administration
- Radiation protection--"as low as reasonably achievable"
- Fire protection
- Industrial hygiene
- Concerns program activities.

3.1.4 Priority D. Compliance Assurance (not covered above)

D1. Prevent nonadherence to U.S. Department of Energy (DOE) orders related to environment and safety, through order interpretation and assessments.

D2. Pursue corrective actions to ensure compliance with DOE orders, through reasonable interpretation of policy thrusts.

3.1.5 Priority E. Conduct of Operations (not covered above)

E1. Pursue effective conduct of operations through the following:

- Procedural development
- Training
- Operational Readiness Review discipline
- Occurrence reporting
- On-time completion of milestones in accordance with the approved baseline.

3.1.6 Priority F. Enhanced Operations

F1. Pursue activities not required by regulation but desirable, such as the following:

- Complying with DOE orders more stringent than external regulations
- Implementing improved management practices
- Accelerating actions to satisfy the milestone ahead of schedule.

3.2 WASTE TANK CORE SAMPLING PRIORITY

The core sampling of the 149 SSTs and the 5 watchlisted DSTs requires a prioritization scheme that encompasses the above criteria, yet recognizes constraints such as moratoriums and safety holds (for example, the present hold on rotary drill core sampling of most watchlisted tanks). The prioritization criteria therefore should focus on subsets of tanks that are "available" for sampling at any given time.

The 23 safety issues and the tanks included under each are presented in Tables 3-1, 3-2, and 3-3. The watchlist tanks are listed in Table 3-4.

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Table 3-1. Priority A1--Hanford Site Waste Tank Safety Issues.

Safety issue	Number of tanks by area and tank farm																		Total tanks
	200 East Area Tank Farm											200 West Area Tank Farm							
	DST					SST						DST	SST						
	AN	AP	AW	AY	AZ	A	AX	B	BX	BY	C	SY	S	SX	T	TX	TY	U	
1. Flammable gas generation in Tank 101-SY and other tanks	3					1	2					2	3	7	1			4	23
2. Potential explosive mixtures of ferrocyanide in tanks									4	10	4				2	1	3		24
3. Potential organic-nitrate reactions in tanks								1			1		1	1		2		2	8
4. Continued cooling required for high heat generation in Tank 106-C											1								1

DST = Double-shell tank.
SST = Single-shell tank.

Table 3-2. Priority A2--Hanford Site Waste Tank Safety Issues.

Safety issues	Number of tanks by area and tank farm																		Total tanks
	200 East Area Tank Farms											200 West Area Tank Farms							
	DST					SST						DST	SST						
	AN	AP	AW	AY	AZ	A	AX	B	BX	BY	C	SY	S	SX	T	TX	TY	U	
5. Insufficient tank contents characterization to support evaluation	All tank farms											All tank farms							177
6. Inadequate safety documentation	All tank farms											All tank farms							177
7. Maintenance and upgrade of tank farm facilities and equipment	Potentially all tank farms											Potentially all tank farms							177
8. Inadequate SST leak detection systems*						All SST farms							All SST farms						149
9. Instrument upgrades in SSTs and DSTs	All tank farms											All tank farms							177
10. Tank safe operating life	All tank farms											All tank farms							177
11. SST emergency pumping									1		6				2			8	17
12. Leaking S-302-A catch tank												All tank farms							86
13. Tank toxic vapor releases	Potentially all tanks											Potentially all tanks							177
14. Improvement in conduct of operations	All tank farms											All tank farms							177
15. Lack of plant essential drawings	All tank farms											All tank farms							177
16. DST space requirements	All tank farms											All tank farms							177
17. Response to a leaking DST												All DST							28

*Issues that could possibly be interpreted as environmental concerns.
DST = Double-shell tank.
SST = Single-shell tank.

Table 3-3. Priority B2--Hanford Site Waste Tank Safety Issues.

Safety issue	Number of tanks by area and tank farm																		Total tanks
	200 East Area Tank Farm											200 West Area Tank Farm							
	DST					SST						DST	SST						
	AN	AP	AW	AY	AZ	A	AX	B	BX	BY	C	SY	S	SX	T	TX	TY	U	
18. Transfer line concrete encasement integrity and secondary containment compliance	To be determined											To be determined							TBD
19. AZ Tank Farm ventilation line					2														2
20. Excessive hydroxide consumption in Tank 107-AN	1																		1
21. Sealing of SSTs to prevent intrusions*						All SST farms							All SST farms						149
22. Improved leak detection in DSTs	All DSTs											All DSTs							28
23. Intertank ventilation connections	All DSTs					3					3	All DSTs		13					47

*Issues that could possibly be interpreted as environmental concerns.
DST = Double-shell tank.
SST = Single-shell tank.

Table 3-4. Priority A Watchlist Tanks.

Safety Issue 1 flammable gas generation	Safety Issue 2 potential explosive mixtures of ferrocyanide	Safety Issue 3 potential for organic-nitrate reactions
A-101	BX-102	B-103
AX-101	BX-106	C-103
AX-103	BX-110	TX-105
S-102	BX-111	U-106
S-111	BY-101	U-107
S-112	BY-103	C-106
SX-101	BY-104	S-102[b]
SX-102	BY-105	SX-106[b]
SX-103	BY-106	TX-118[b]
SX-104	BY-107	
SX-105	BY-108	
SX-106	BY-110	
SX-109	BY-111	
T-110	BY-112	
U-103	C-108	
U-105	C-109	
U-108	C-111	
U-109	C-112	
AN-103[a]	RT-101	
AN-104[a]	T-107	
AN-105[a]	TX-118	
SY-101[a]	TY-101	
SY-103[a]	TY-103	
	TY-104	

[a]Double-shell tank.
[b]Also listed under a higher safety issue.

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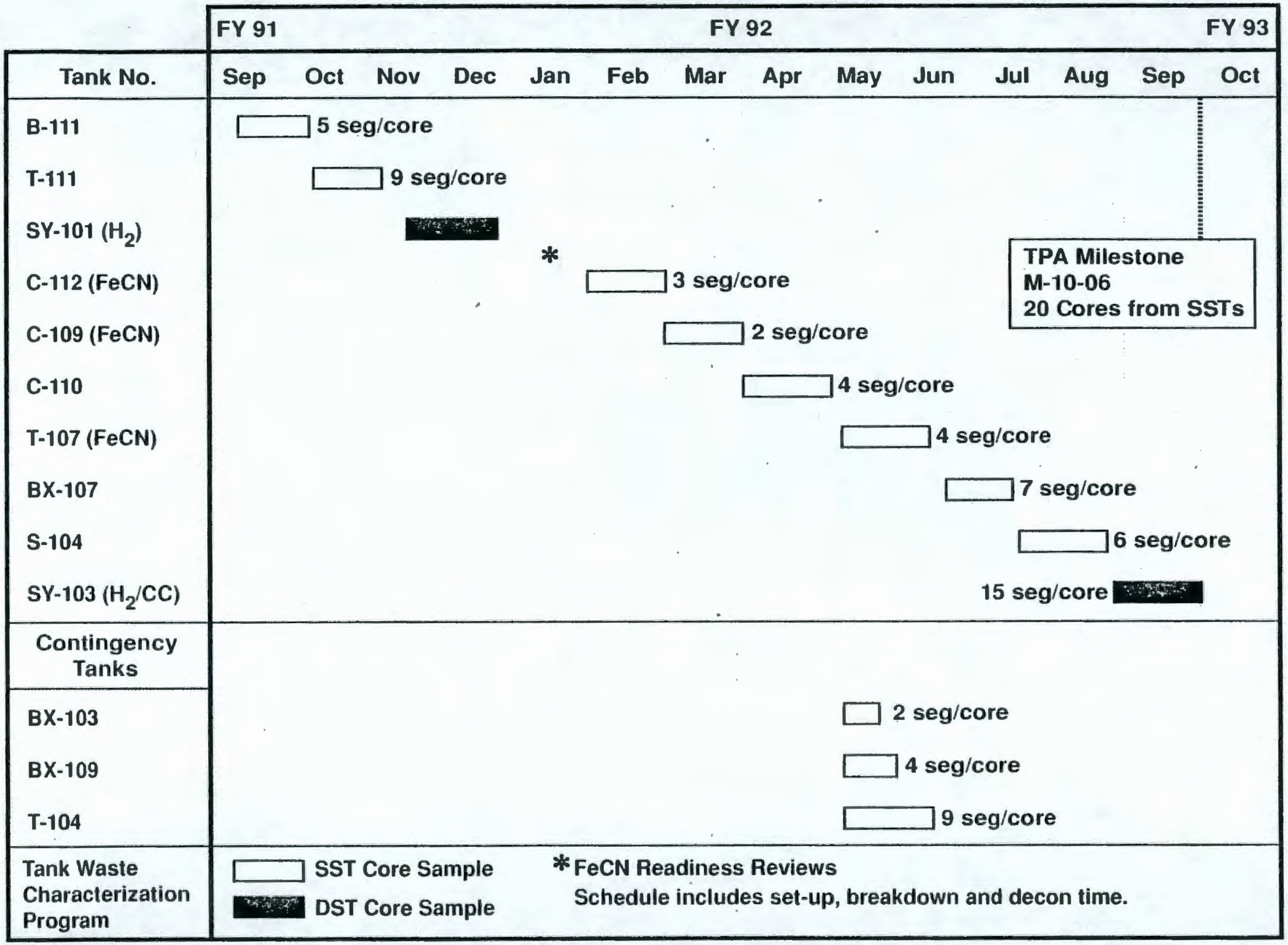
4.0 INTEGRATED SCHEDULE

The integrated sampling schedule is presented in Table 4-1. The schedule for each program is presented by fiscal year. The current schedule for core sampling is shown in Figure 4-1. Figure 5-1 and Figure 5-2 are a graphical presentation of the data in Table 4-1 individually by year and cumulative for the period 1992 through 1998.

Table 4-1. Projected Program Sampling and Analytical Needs by Fiscal Year.

Program	1992	1993	1994	1995	1996	1997	1998	Total samples	Total AEU
Watchlist SSTs	6	12	23	28	25	--	--	94	103
Other SSTs	10	14	20	31	27	60	42	204	122
Watchlist DSTs	4	2	2	2	--	--	--	10	23
Nonwatchlist DSTs (solids)	5	5	6	6	6	6	6	40	24
Grout Vault	4	4	5	6	7	7	6	39	8
Retest	6	4	4	4	4	4	4	30	12
Interim Isolation and Stabilization	22	14	12	12	--	--	--	60	12
242-A Evaporator	10	10	15	35	35	32	31	168	17
Grout Feed	32	32	33	33	--	--	--	130	13
Nonwatchlist DSTs (liquid)	22	22	25	25	20	20	16	150	15
N and K Basin Sludge	20	20	20	20	10	--	--	90	18
Soil Remediation	35	65	100	100	100	100	100	600	60
Solid Waste Characterization	0	25	25	25	25	--	--	100	10
Waste Receiving and Packaging	0	0	0	0	0	50	50	100	10
SST/DST Remediation	0	0	5	8	12	15	20	60	36

AEU = Standard analytical equivalency unit.
DST = Double-shell tank.
SST = Single-shell tank.



CC = Complexant concentrate
DST = Double-shell tank
FY = Fiscal year
SST = Single-shell tank
TPA = Tri-Party Agreement

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Figure 4-1. Fiscal Year 1992 Core Sample Schedule by Tank for Characterization of Single-Shell and Double-Shell Tanks.

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5.0 ACTIONS NECESSARY TO SUPPORT MILESTONE M-10-00

5.1 ANALYTICAL LABORATORIES

To meet Milestone M-10-00, the planned laboratory upgrades described in Section 2.1 must be funded and implemented ahead of the current schedule. The implementation dates necessary to meet the milestone are presented in Table 5-1. The laboratory throughput rates that will result from implementation of these upgrades are shown graphically in Figure 5-1 (annual) and Figure 5-2 (cumulative).

At this time, there is no plan to modify the 222-S Laboratory or the PNL Analytical Chemistry Laboratory for large-quantity alpha analysis; therefore, the alpha needs for the Solid Waste and Waste Receiving and Packaging Programs are not addressed in this evaluation except for a small number of AEUs for investigative or process development work.

Table 5-1. Laboratory Upgrades Necessary to Meet Milestone M-10-00.

PNL Analytical Chemistry Laboratory

Upgrades	Necessary implementation
Facility upgrades	
B-Hot Cell renovation	September 1993
Sample Receiving Facility	September 1993
Standards Laboratory	September 1993
Radiochemistry Laboratories	September 1995
Inorganic Laboratories	September 1995
Instrumentation upgrades	Can be implemented 12-18 months earlier than planned with receipt of adequate funding
A-Hot Cell cleanout	September 1994
Increase analytical staffing	
B-Hot Cell staff (second shift)	October 1994
Data review and data package preparation (double staff size)	October 1994
Full Laboratory Information Management System (LIMS)	September 1994

222-S Laboratory

Upgrades	Necessary implementation
Interim laboratory information management system	N/A
PQ shift	June 1992
Second inductively coupled plasma unit	N/A
Full laboratory information management system (LIMS)	June 1993
Staff to 7 days/week, 10 hours/day	June 1993
New hot cell startup (HVAC and electrical upgrades)	June 1994

HVAC = Heating, ventillation, and air conditioning

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Figure 5-1. Annual Analytical Laboratory Throughput Versus Combined Programmatic Analytical Needs.*

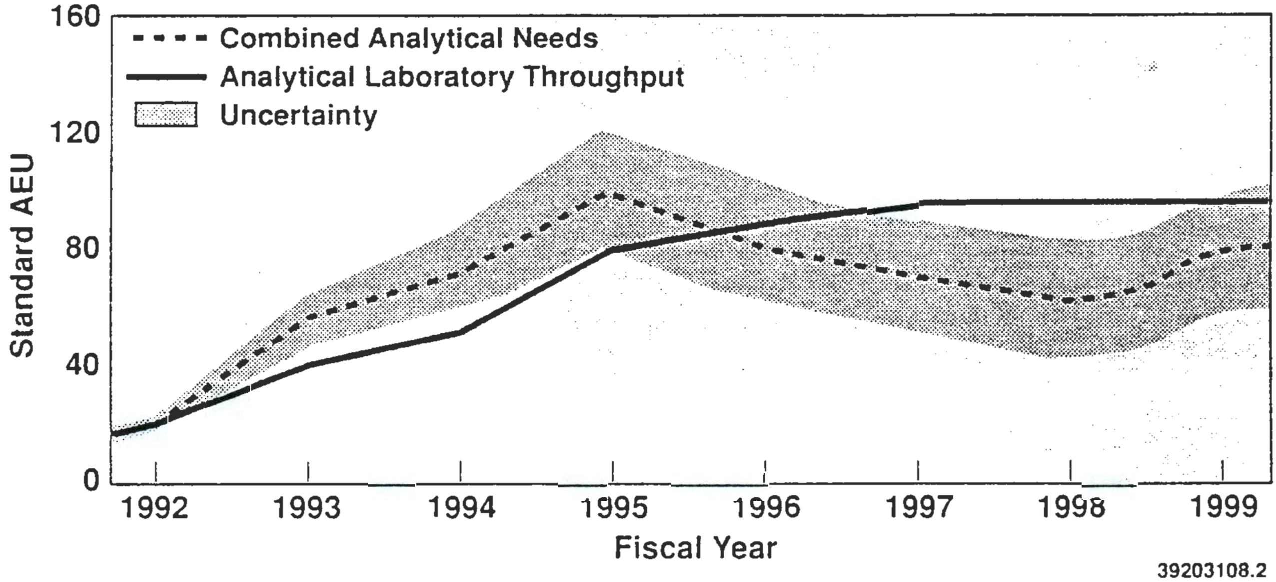
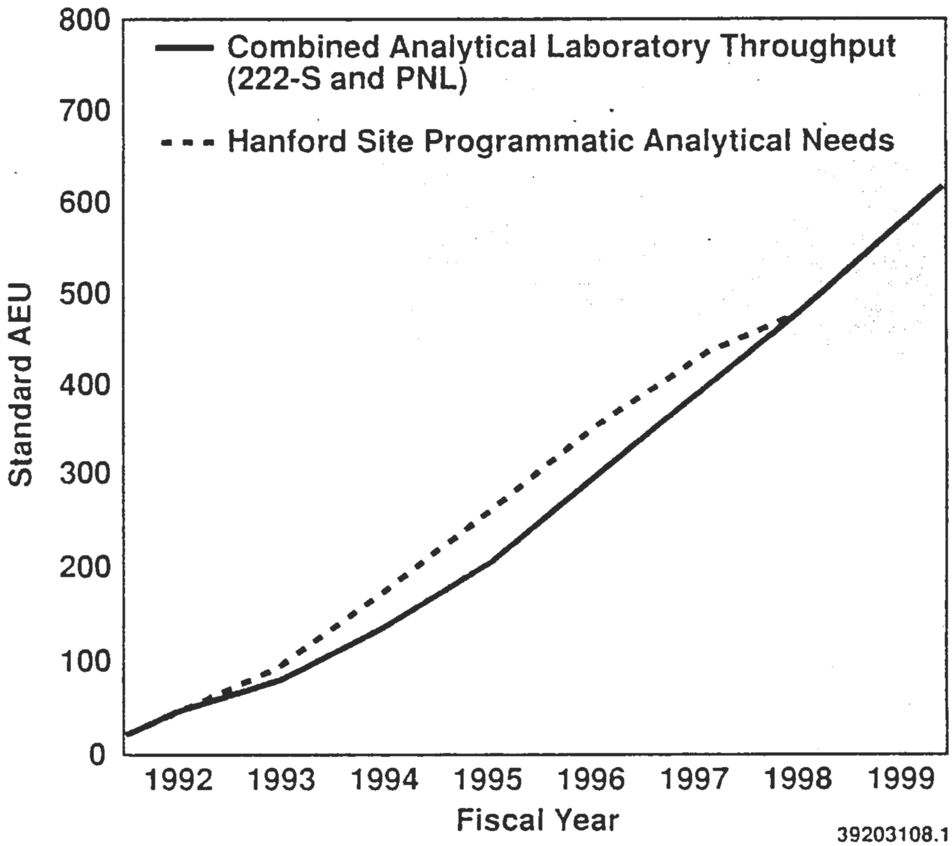


Figure 5-2. Cumulative Analytical Laboratory Throughput Versus Combined Programmatic Analytical Needs.



*This enhanced throughput capacity is contingent upon implementation of the necessary laboratory upgrade schedule, Table 5-1.

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6.0 OPPORTUNITIES FOR ACCELERATION

The General Accounting Office reviewed the Hanford Site laboratory upgrade plan and analytical costs in 1990. The review concluded that the strategy for upgrade of the 222-S Laboratory and the PNL Analytical Chemistry Laboratory was the most cost-effective alternative for long-term laboratory support.

Any acceleration options that significantly increase the laboratory throughput capabilities must be accompanied with commensurate increases in planning, sampling, data package preparation, and other support staffing to ensure that these elements of the program do not become limiting factors.

6.1 PRIORITIZATION

Adjustment of the priorities for the other Hanford Site sampling and analytical programs could also result in an acceleration of the waste characterization programs. 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.

6.2 FULL TANK WASTE RETRIEVAL DECISION

At present, Hanford Site analytical planning is based on a leave/retrieve decision requiring full regulatory protocol for all waste characterization analyses. A full waste retrieval decision could eliminate the need for a complete characterization of the waste before treatment as required by Federal and Washington State hazardous and mixed waste regulations. This option could reduce the laboratory burden by as much as 25% for SSTs. Additionally, preprocessing efforts could be streamlined through blending of tank waste stored in the 32 SSTs containing less than 150,000 L (40,000) gal of waste. A limited number of analyses could be performed on a single core sample from one tank once the waste from low volume tanks has been transferred and blended. A more detailed evaluation of the overall benefits of an SST waste retrieval decision will be completed this year.

6.3 SHIPPING OFFSITE

Shipping samples to labs on other DOE sites for analysis may be another possibility. This is not an attractive option because of the issues related to packaging and offsite transportation of the samples and because of the probable resistance by the states enroute and at the receiving sites. Further, the amount of excess capacity in these labs will probably decrease as the other sites expand their own remediation programs.

6.4 PUREX LABORATORY

The PUREX laboratory has insufficient floor space (hoods, etc.) to serve as a fully functional environmental laboratory for RCRA/CERCLA samples with activity of greater than 10 mrem/hour. However, the PUREX laboratory space and limited equipment could provide backup services for selected analyses, and training for laboratory technicians. The backup services and training alternatives are presently being evaluated.

The laboratory space could also be used for selected development activities. This would require the transfer and installation of equipment to PUREX.

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7.1 REFERENCES

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APPENDIX A

WASTE CHARACTERIZATION FUNCTIONAL RESPONSIBILITIES

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WASTE CHARACTERIZATION FUNCTIONAL RESPONSIBILITIES

The Hanford Site, established in 1943, is a 1,450-km^2 (560-mi^2) installation of the U.S. government in southeastern Washington. The site is managed by the U.S. Department of Energy (DOE). Historically, the Hanford Site mission has been tied to the materials production goals of DOE and the U.S. Department of Defense. Currently, activities are focused on environmental restoration, remediation of production plants and ancillary facilities, and disposal of radioactive and hazardous defense wastes and mixtures of the two. Westinghouse Hanford Company (Westinghouse Hanford) and Pacific Northwest Laboratory (PNL), have primary responsibility for conducting the DOE programs and managing Hanford Site facilities. This section identifies organizations functionally responsible for the Hanford Site sampling and analytical programs and their responsible divisions.

A.1 WESTINGHOUSE HANFORD COMPANY

Westinghouse Hanford, a wholly owned subsidiary of the Westinghouse Electric Corporation, is the operations and engineering contractor at the Hanford Site. Westinghouse Hanford leads the cleanup and environmental restoration efforts under the *Hanford Federal Facility Agreement and Consent Order* (Tri-Party Agreement) (Ecology et al. 1990). Westinghouse Hanford operates DOE facilities such as the Fast Flux Test Facility and other engineering development, chemical processing, and defense waste facilities. Westinghouse Hanford also manages the site support services for DOE. A brief description of Westinghouse Hanford Departments and organization responsibilities follows. Figure A-1 shows the Westinghouse Hanford Organization.

A.1.1 Tank Waste Remediation Systems

The Westinghouse Hanford Tank Waste Remediation Systems Division (TWRS) operates facilities associated with the receipt, containment, storage, and handling of liquid high-level wastes at the Hanford Site, excluding those waste facilities and systems under the control of the operator of the process generating the waste. Major activities of TWRS include the technical, operational, and programmatic functions required to ensure the safe, secure, environmentally sound operation of the 200 Area nuclear waste tank farms, their associated facilities and equipment, and the 242-A Evaporator. Activities include the plant, process, and systems engineering necessary to support and optimize waste tank operations, to identify and evaluate equipment and process improvements, to evaluate and recommend future activities, and to ensure compliance with applicable Federal, State, and local regulations.

In addition, TWRS has responsibility for the retrieval, pretreatment, and vitrification of Hanford Site high-level wastes and the solidification of selected wastes in the Grout Facility.

A.1.1.1 Waste Tank Safety Program Group. The Waste Tank Safety Program Group (WTS) is responsible for evaluation, planning, scheduling, and execution of the programs to remediate the safety issues associated with the tanks farms, in particular, those issues related to the "watchlist" tanks. (The watchlist tanks are those that generate excessive hydrogen, contain significant quantities of ferrocyanide or organics, or generate excessive heat.) Development of approved remediation plans requires that the tank wastes be sampled to fully characterize the chemical and physical properties of these wastes. Core samples taken from these tanks can provide data for the *Resource Conservation and Recovery Act of 1976* (RCRA) characterization program also.

A.1.1.2 Characterization and Safety Technology Group. Under TWRS, the Characterization and Safety Technology Group is charged with the specific tasks of waste tank sample planning; and identifying, coordinating, and integrating multi-programmatic research, development, demonstration, testing, and evaluation technology and activities in support of the tank waste characterization program.

A.1.2 Restoration and Remediation Department

The Restoration and Remediation Department has among other obligations the responsibility for groundwater monitoring and the decontamination, decommissioning, and site remediation pertaining to the Hanford Environmental Restoration and Remedial Action Program.

A.1.2.1 Environmental Engineering and Geotechnology. The Environmental Engineering and Geotechnology Group is responsible for restoration and remediation for groupings of past-practices waste sites, called operable units. The operable units consist of cribs, ponds, trenches, ditches, landfills, spills, and other contaminated or hazardous areas that received liquid wastes from varied Hanford Site operations. They are the main source of groundwater contamination at the Hanford Site. Depending on the type of waste site and the lead regulatory agency, each operable unit has been designated to be characterized and remediated under the *Comprehensive Environmental Response Compensation and Liability Act of 1980* (CERCLA) or RCRA site restoration process. The two processes have been integrated at the Hanford Site so that they are essentially the same.

Site restoration is initiated with the preparation of a work plan, which lays out the plans for the first phase of characterization and the initial screening of remedial alternatives. Upon completion of the first phase of characterization, a supplemental work plan is prepared to plan any additional characterization activities and make the final remediation choice. The overall process results in a record of decision (ROD) issued by the lead regulatory agency. Upon approval of the ROD, the remedial action design can be initiated followed by the remediation.

A.1.3 Facility Operations Division

The Facility Operations Division, through the Processing and Analytical Laboratories (PAL) Department, operates the 222-S Laboratory and provides a variety of analytical services for the Hanford Site including the processing and analysis of waste tank core samples. The Office of Sample Management (OSM) in this department is responsible for the planning, coordination, and negotiation of sitewide activities between site programs and onsite and offsite analytical/chemical laboratories.

A.1.3.1 Processing and Analytical Laboratories Department. The PAL Department is responsible for overseeing all Westinghouse Hanford analytical laboratory activities onsite. As described below, the OSM, Sample Control and Scheduling Management Function, and Facility Operations Function all fall under Analytical Services Department management. Other group management responsibilities cover long-range laboratory integration planning and control, technical services such as projects and upgrades, analytical operations and management of site process laboratories.

A.1.3.2 Office of Sample Management. The Westinghouse Hanford OSM, under the PAL Department of the Facility Operations Division, provides coordination between all organizations taking samples and laboratories providing analytical services.

In this role, the OSM assists programs with regulatory and other requirements are met throughout each step of the sampling and analysis processes, so the final results can be certified.

The OSM advises the organizations taking samples on the various regulatory requirements that must be met. This advice generally includes specifications on sample sizes, sample containers, and chain of custody. The OSM reviews and comments on work descriptions prepared by the organizations to implement these sampling requirements.

The OSM works with the sampling organization, the program, and the appropriate lab(s) to define the analyses for each sample; the methods, procedures, and controls to be applied in the lab; and a schedule for obtaining, delivering, and analyzing the sample(s).

Once the various organizations are ready, OSM will schedule the activities and will provide coordination and tracking of the sampling and shipping process to ensure samples get to the correct lab under prescribed conditions and times.

The OSM is responsible for preparation of procurement specifications for offsite laboratory services and for procurement of sufficient services to support Hanford Site program needs. As part of the procurement process, OSM performs lab assessments to ensure each lab has the required quality assurance programs, equipment, procedures, trained personnel, and certifications to perform the desired analyses. (At the present time, OSM has five offsite labs under contract, including K-25 in Oak Ridge, Weston, Data-Chem, Maxwell-S^3, and TMA.)

In addition to providing specifications for sampling and analytical programs, OSM is responsible for tracking, verifying, and reporting and transmittal of the data. The OSM initiates these activities by issuing identification numbers for all samples taken under their purview. Routine status reports are compiled by sample number. Once a lab has completed the requested analyses, results and backup information are forwarded to OSM for verification and validation. When the data is verified and validated, it is sent to the requesting program. The validated data packages are transmitted to the Environmental Data Management Center.

In addition, summary sample and analysis data is entered into the Hanford Environmental Information System (HEIS). The HEIS is the official site database for all types of information related to site remediation/restoration programs. It will be the source point for most offsite users of this information. This program, which is still under development, will be run by PNL.

A.1.3.3 222-S Laboratory Operations. The 222-S Laboratory is Westinghouse Hanford's primary laboratory. It comprises about 6,500 m^2 (70,000 ft^2) of laboratory space containing about 150 hoods and analytical hot cell space which employs 12 remote manipulators. The laboratory has provided analytical chemistry support for Hanford processing plants; initially for the Redox Plant in the 1950s and later including Plutonium-Uranium Extraction (PUREX), Plutonium Finishing Plant (PFP), B Plant, Waste Encapsulation and Storage Facility, the Grout Program, and the 242-A and 242-S Evaporators. Support has also been provided to the tank farms.

In one way or another, the 222-S Laboratory supports all activities in the 200 Areas. Samples are received and analyzed from environmental and effluent monitoring, chemical processing, and waste management activities. Analysis of environmental, effluent, process chemical, and nonroutine samples are conducted on the day shift. Environmental and effluent samples include liquid effluents, ground and surface waters, soil, animals, vegetation, and air filters.

Present activities include continuing analysis of Tank Farm process control samples and continued analysis of grout formulation and process control samples.

Past waste tank support work includes waste sampling before discharge to waste tanks, tank farm process control samples, and Phase IA and IB trial runs of the SST Characterization Program. Examples of past process support activities include sample analyses for the Waste Encapsulation and Storage Facility cesium and strontium encapsulation processing, and development for grout formulation activities.

A.1.3.4 222-S Sample Control, Scheduling, and Data Management Function. The Sample Control, Scheduling, and Data Management Function (SCSD) under the PAL Department is responsible for the day-to-day planning, scheduling, and tracking of analytical activities and support activities within the 222-S Laboratory. The SCSD ensures that the analytical work is performed according to established priorities and schedules and within the procedure and quality control guidelines set for each program. The SCSD is also responsible for preparation of the RCRA characterization data packages.

A.2 BATTELLE MEMORIAL INSTITUTE, PACIFIC NORTHWEST LABORATORY

Battelle operates the DOE PNL, a multi-program national laboratory and the research and development center for the Hanford Site. The PNL's capabilities include several laboratories in the 300 Area that support operation of the Fast Flux Test Facility, the characterization of high-level nuclear waste, research and development, and environmental monitoring for the 300 and 400 Areas. Figure A-2 shows the PNL organization.

A.2.1 Analytical Chemistry Laboratory

The PNL Analytical Chemistry Laboratory has the primary responsibility to provide analytical chemistry support to a wide spectrum of Hanford Site programs. Laboratory staff and equipment are housed in several buildings within the 300 Area--325, 329, 314, and 3708--and occupy approximately 3,000 m^2 (30,000 ft^2) of actual laboratory space. Programs supported include numerous PNL and Westinghouse Hanford research and development programs, several aspects of the operation of the Fast Flux Test Facility, Hanford Site environment and safety monitoring programs, Hanford Site waste management operations, tank characterization and safety investigations, and Hanford Site environmental restoration activities. A full range of radiochemical, inorganic, and organic analysis capabilities reside within the Analytical Chemistry Laboratory, including semi-routine analyses, methods development and application activities, and the ability to prepare all data packages to U.S. Environmental Protection Agency Contract Laboratory Program (CLP) standards.

A.2.2 327 Building, Postirradiation Testing Laboratory

The 327 Postirradiation Testing Laboratory provides shielded, ventilated, and specially equipped laboratories for physical and metallurgical examination and testing of irradiated fuels, concentrated fission products, and structural materials. The examination and testing are carried out in 12 shielded cells equipped with viewing windows, manipulators, and required machinery. One of the cells has an inert nitrogen atmosphere for the examination and testing of materials that would be adversely affected by an air atmosphere. The remaining cells have an air atmosphere. In addition, the building has a low-level waste compaction station used to compact waste generated in the 327 Building and waste from other 300 Area buildings.

The 327 Laboratory also has 810 three-inch-square by eight-inch-deep shielded storage spaces for high-dose-rate radioactive materials. These spaces can hold up to 7 g of fissile material each, while the entire facility can handle 600,000 Ci. A cask unloading cell complete with small shipping casks and a transfer cask to move materials from the unloading cell to the storage location is also available.

A.2.3 High-Level Radiochemistry Facility

A separate PNL organization is the High-Level Radiochemistry Facility, which is also located within the 325 Building. This facility (also called the "A Cell Complex") has historically focused principally on chemical process development activities, at the pilot plant scale. It is within this facility that Hanford Site waste tank core samples are extruded, homogenized, and sub-sampled and where most of the physical testing on this core material takes place. Tank samples are transferred to the 325 B Hot Cell Facility after processing in the A Cell Complex has been completed.

Figure A-1. Westinghouse Hanford Company Directly Related Organizations.

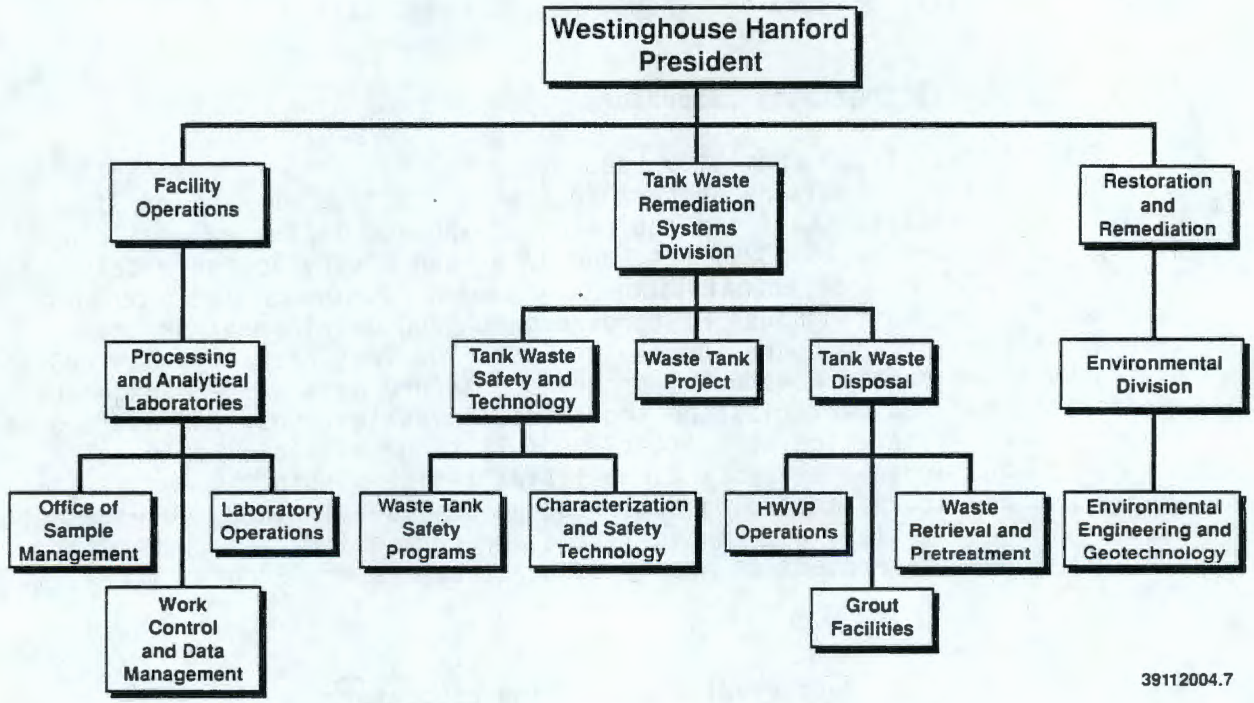

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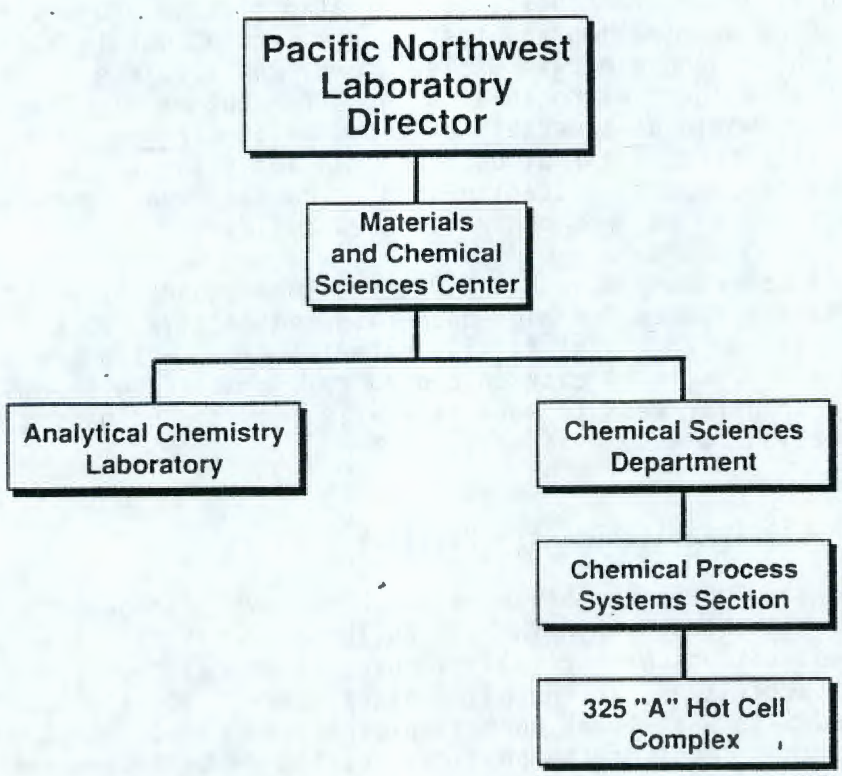
Figure A-2. Pacific Northwest Laboratory Directly Related Organizations.



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APPENDIX B

PRIMARY SOURCES OF >10 MREM/HOUR SAMPLES

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PRIMARY SOURCES OF >10 MREM/HOUR SAMPLES

B.1 HANFORD WASTE TANKS

B.1.1 Description and Background

Radioactive liquid waste, a by-product of the chemical processing of irradiated nuclear reactor fuel, is stored at the Hanford Site in large underground tanks. Because of various waste management processes over the years, the tanks contain mixtures of liquids, precipitated sludge, and/or salt cake formed during evaporation.

A total of 149 single-shell tanks (SST) were constructed and placed in service between 1943 and 1964. All SSTs were taken out of routine liquid waste storage service by November 21, 1979. Twenty-eight newer double-shell tanks (DST) were constructed and placed in service between 1968 and the mid-1980s. All of the DSTs are still in service.

All of the high-level waste tanks are in separate groupings that are referred to as tank farms. Both SST and DST farms are located in the 200 East and 200 West Areas of the Hanford Site, and have transfer capabilities (generally in underground double-encased pipes) for waste transfers between chemical and waste processing facilities, waste tanks, and waste tank farms.

The SSTs are located in 12 separate tank farms. One hundred thirty-three of the SSTs are 23 m (75 ft) in diameter with nominal capacities of 2,000,000 to 3,800,000 L (530,000 to 1,000,000 gal). Sixteen of the tanks are smaller units of similar design with a diameter of 6.1 m (20 ft) and a capacity of 189,000 L (50,000 gal). The larger SSTs are reinforced-concrete, cylindrical, dome-roofed, buried tanks with a carbon steel liner across the bottom welded to the carbon steel liner up the walls. Loads are carried by the reinforced-concrete tank and dome. The steel liner provides containment for the waste.

The SST waste consists of about 137,000 m^3 (36,000,000 gal) of solids, and about 26,000 m^3 (7,000,000 gal) of interstitial liquid and supernate. The solids consist of 90,000 m^3 (23,500,000 gal) of salt cake, and 47,000 m^3 (12,500,000 gal) of sludge.

During the 36 years that the 149 SSTs were in active service, the contained wastes have been intermixed, concentrated, and treated to remove long-lived fission products. Therefore, the contained radioactive and hazardous waste content of each tank is not well known, and to support timely development of tank waste retrieval technology and assist in tank closure, multiple representative samples must be obtained from each tank.

The DSTs, which incorporate the concept of double containment, have a nominal capacity of 3,800,000 L (1,000,000 gal) and are located in six separate tank farms. They are 23-m (75-ft)-diameter, reinforced-concrete, cylindrical, dome-roofed, buried tanks with two steel liners. There is a nominal 76-cm (30-in.)-air gap between the primary steel liner and lined reinforced-concrete tank wall. The primary steel liner consists of a floor, an independent 23-m (75-ft)-diameter cylindrical shell, and a dome that is integral with the reinforced-concrete dome. The primary liner provides the waste containment and carries the inner surface of the reinforced-concrete tank wall and bottom. The reinforced-concrete tank and dome carry the surface loads and the static and dynamic soil loads.

The DST waste consists of about 73,000 m^3 (19,300,000 gal) of supernatant, 18,000 m^3 (4,800,000 gal) of solids (slurry, sludge, and salt cake), and 1,500 m^3 (400,000 gal) of interstitial liquid.

Because the DSTs store dangerous waste for more than 90 days and/or are treated waste designated as dangerous or extremely hazardous, the tanks are required to be permitted for operation under the *Dangerous Waste Regulations* of the Washington State Department of Ecology (Ecology 1991) and the *Resource Conservation and Recovery Act of 1976* (RCRA). The RCRA land disposal requirements and permitting regulations do not allow for continued DST storage of high-level waste in an untreated form. For permitting and treatment activities, the contents of the tanks need to be characterized and a plan of treatment chosen.

All DSTs and 11 SSTs with significant heat loads (greater than 40,000 Btu/hour) have active ventilation systems (air-lift circulation and condensers on aging-waste DSTs and electrical-powered exhauster through high-efficiency particulate air filters on the remaining DSTs and the 11 SSTs). The remaining SSTs have passive ventilation through high-efficiency particulate air filters.

Fifty-three tanks (48 SSTs and 5 DSTs), referred to in this report as "watchlist tanks," have been identified as having serious safety concerns. Ferrocyanide was added to a number of tanks in the 1950s as a result of a program to increase available SST space. Twenty-four tanks may have received enough of the ferrocyanide mixed with the sodium nitrate/nitrite to explode if they are heated to high enough temperatures. Twenty-three tanks periodically generate sufficient quantities of hydrogen and other gases to create a potential for fire or explosion. Eight tanks contain solid salts with high organic material content, which are also potentially flammable. In addition, one SST requires water to be added to replace water evaporated by high radioactive decay heat loads. Three tanks are on more than one of the above lists.

B.1.2 Waste Tank Characterization Sample Projection

Milestone M-10 of the *Hanford Federal Facility Agreement and Consent Order* (Tri-Party Agreement) (Ecology et al. 1990) commits Westinghouse Hanford Company to take and analyze at least two core samples each from the 149 SSTs by September 1998, for a total of 298 cores. Interim milestones specify incremental increases in the number of SST core samples taken annually until 1994. From 1994 to completion, 44 SST core samples are scheduled to be taken and analyzed annually.

The five DSTs on the watchlist will also be core sampled as part of the waste tank safety issue remediation program. For purposes of this study, it is assumed that a minimum of two core samples will be taken from these tanks, for a total of 10 cores. This sampling is scheduled to be completed by September 1996.

A tank core sample is a continuous sample of salt cake and/or sludge, and it is taken from the surface of the waste to near the bottom of the tank in 48-cm (19-in.) segments (about 250 ml if a full segment is obtained). A core may contain up to 22 segments, depending on the depth of the waste. The average tank core sample is estimated to consist of 5.8 segments.

B.2 242-A EVAPORATOR AND LIQUID EFFLUENT TREATMENT

B.2.1 Program Description

The 242-A Evaporator is located in the 200 East Area of the Hanford Site. The process includes a feed tank, a reboiler with a vapor-liquid separator, a condensate system, and a slurry system. The facility also includes a control room; a loading room; heating, ventilation, and air conditioning system; and change rooms. All waste processed in the evaporator comes from the DSTs.

In response to RCRA concerns about the discharge of material from the 242-A Evaporator to DSTs, the 242-A Evaporator is currently being upgraded. Treated effluent from the 242-A Evaporator and other site liquid waste streams will be provided by the construction of several different facilities.

Following upgrades, the 242-A Evaporator will begin processing dilute DST feed. By October 1992, all available dilute feed will have been processed and the 242-A Evaporator will be shut down and placed in standby status. The evaporator condensate generated during operation (13,000,000 gal) will be stored on an interim basis in the Liquid Effluent Retention Facility (LERF).

A new Liquid Effluent Treatment Facility will start up in fiscal year (FY) 1994 and will remain in operation throughout the site cleanup period. This facility will require approximately 8 months to process the 49,000,000 L (13,000,000 gal) of effluent stored in the LERF basins. Treated effluent from the facility will be discharged to a State Approved Land Disposal Structure. In compliance with Tri-Party Agreement interim Milestone M-26-04, all hazardous waste residues remaining in the LERF after effluent processing are to be removed by June 1995.

The 200 Area Treated Effluent Disposal Facility (TEDF) will collect and dispose of 200 East and 200 West Area Phase I effluents and priority Phase II streams. The 200 Area TEDF will also use the Effluent Treatment Facility for standby treatment capability. Tri-Party Agreement interim Milestone M-17-08 will be met by startup of the 200 Area TEDF by June 1995.

The 300 Area TEDF will provide the capability to treat and dispose of effluents currently discharged to the 300 Area Process Trenches. Effluents will be collected, treated, and discharged to the Columbia River under a National Pollutant Discharge Elimination System permit. Tri-Party Agreement interim Milestone M-17-09 will be met by startup of the 300 Area TEDF by December 1994.

Sampling and analysis requirements of the 242-A Evaporator and the liquid effluent treatment facilities include environmental documentation activities, initiating and acquiring Ecology approval of all known and reasonable technologies for the treatment technology, verifying treatment technology with benchscale testing and a pilot plant, verifying influent data for the LERF with compilation and analysis to support permitting activities, and finalizing and acquiring approval of the disposal site and discharge levels from Ecology. The major focus of sampling and analysis for the 200 and 300 Area TEDFs is on characterization of the influent and effluents, treatment technology, and permitting.

B.2.2 Sample Projection

Double-shell tank feed will be processed through the evaporator in 14 campaigns. The DST waste will be transferred to the evaporator feed tank, 102-AW, in batches, sampled, and analyzed prior to processing. Each batch will require 12 samples before campaign initiation.

B.3 GROUT OPERATIONS

B.3.1 Program Description

Beginning in 1993, the Hanford Site Grout Disposal Program will begin implementation of a major disposal action--grouting and near-surface final disposal of the low-level waste portion of the Hanford's 40-year accumulation of defense tank waste. This method of disposal is a significant step forward in the U.S. Department of Energy (DOE) plan for final disposal of tank wastes. In addition to putting this environmentally positive program in motion, the Grout Disposal Program will also relieve pressure on the DST storage system capacity as well as reduce the environmental risk of continued liquid waste storage in tanks. The Grout Program's goal of final disposal is to support Hanford Site operations by maintaining acceptable storage volume using the existing 28 DSTs.

The process of grouting waste involves blending a specified mixture of dry materials (fly ash, Portland cement, slag, and diluent) with the waste in a specified ratio, and at a consistent and monitored flow rate to successfully immobilize low-level waste in near-surface grout vaults. The grout vaults are designed to meet the requirements established by the Washington State

Department of Ecology and the U.S. Environmental Protection Agency for hazardous waste disposal, including a double-liner/leachate collection system.

As a result of negotiations between Tri-Party Agreement members, a 27-month delay in the completion of originally established grout technology and operations milestones was established. The delays are necessary due to the following:

- The changing complexity of safety analysis, which has added new requirements for equipment that must be designed, procured, fabricated, and installed

- The need for grout reformulation and verification to resolve excessive grout temperatures and verification of agreement with applicable guidance contained in U.S. Nuclear Regulatory Commission requirements.

B.3.2 Sample Projection

The Grout Program has two differing sampling and analyses components. The Grout Feed Sampling Program will involve sampling 13 batches of feed material in either 102-AP or 104-AP. Ten samples will be taken for each batch. The Grout Vault Block Core Program will involve 13 vaults producing three core samples each.

B.4 N REACTOR CLOSURE PROGRAM AND K AREA BASINS

B.4.1 Program Description

N Reactor was designed as a dual-purpose, 4,000 MWt and 860 MWe light-water graphite-moderated nuclear reactor that irradiated uranium for plutonium production and supplied by-product steam for offsite electrical generation to the Washington Public Power Supply System Hanford Generating Plant. The plant last operated in 1987. The DOE-Headquarters issued a Shutdown Directive in September 1991. Before the directive, the plant had been in dry layup standby status, and planning had been initiated for facility turnover to the Hanford Surplus Facility Program by 1997.

The Five-Year Plan (DOE 1991c) calls for several activities associated with N Reactor shutdown. These activities include the following: (1) maintaining systems and facilities that are planned to remain in operation--N Basin, 107N Basin Recirculation System, and other systems required for health, safety, and environmental compliance considerations; (2) program management; (3) RCRA permits and closures; (4) facility compliance modifications; (5) Facility Effluent Monitoring Plans; (6) N Springs; and (7) shoreline dose reduction. Additionally, several fuels fabrication facilities located in the 300 Area are included in the N Reactor shutdown activities.

The effluent monitoring activities consist of sampling, analysis, and reporting, and are incorporated into operating procedures and periodic program reviews that are evaluated annually for compliance against regulatory changes and facility system configuration. N Springs activity will assess the nature and extent of radioactive contamination inventory in the 100N liquid waste disposal facilities, which in turn are the source of radioactive releases to the Columbia River. The shoreline dose reduction activity will determine alternative methods for reducing the radiation dose levels along the 100N shoreline that exceed DOE limits. Reduction activities will continue until levels are in compliance.

A separate activity included in the Five-Year Plan (DOE 1991c) will quantify the radiological and chemical content of the residual material contained in the N Reactor and KE and KW fuel storage basins, basin recirculation systems, building sumps, and water treatment systems. Formal sampling and analysis of this material will lead to full characterization and is required to determine proper disposition of environmental and personnel considerations, and to determine the most effective methodology for material disposition. The plan calls for cleanup activities to be completed in 1996.

Support from the Hazardous and Radiological Waste Control organization will be required to meet projected timetables. The scope of work includes issuing approved containers; packaging; sampling; proper segregation; and storage and shipment of hazardous, nonhazardous, radiological, and mixed waste. It is extremely difficult to project the volume of waste that some of these activities will produce due to the nature of the work and the uncertainty of what will be encountered in the actual performance of the work.

The KE and KW Reactor facilities became operational in 1951 to support plutonium production goals. Reactor operation was discontinued in the late 1960s. In 1975 the KE storage basin was modified to provide short-term storage for irradiated N Reactor fuel until it could be processed at the Plutonium-Uranium Extraction Facility. The KW storage basin was placed into service for the same purpose in 1981. The basins are each 38 m (125 ft) long, 20 m (67 ft) wide, and 6 m (21 ft deep). A water depth of 5 m (16 ft) is maintained. The water circulation systems includes filters, ion exchangers, and chillers.

The Five-Year Plan includes activities to provide for interim irradiated and unirradiated fuel storage. Specific activities will be to encapsulate 3,659 open canisters in the KE storage basin, re-encapsulation of the fuel stored in 1,773 MK I (aluminum) canisters in the KW storage basin, and preparation of empty canisters for disposal. Additional activities will support storage basin upgrades, maintenance, and operations. Studies will also be undertaken to determine the long-term disposition of irradiated fuel stored at the Hanford Site. Additional waste handling and management activities have been included in projected activities associated with N Reactor shutdown.

Waste management and sampling activities are required to safely operate the KE and KW facilities, handle, treat, store, and/or dispose of wastes generated by storage basin operations. Materials will include transuranic waste, low-level waste, low-level mixed waste, and radioactive mixed waste.

Waste management and sampling activities are required to safely handle, treat, store, and/or dispose of waste generated by activities involved with N Reactor shutdown. Materials will include transuranic waste, low-level waste, low-level mixed waste, radioactive mixed waste, and nonradioactive hazardous waste.

B.4.2 Sample Projection

In support of the basin cleanup activities at N Reactor and the K Area, a total of 90 sludge samples will be taken (45 for each area). Each sample will involve a direct anion, direct metal, and fusion dissolution analysis.

B.5 SOIL REMEDIATION CHARACTERIZATION PROGRAM

B.5.1 Program Description

Throughout the Hanford Site, there are groupings of past-practice waste sites, called operable units, that consist of cribs, ponds, trenches, ditches, landfills, spills, and other contaminated or hazardous areas. The operable units are primarily the recipients of liquid wastes from varied site operations. The operable units are the main source of groundwater contamination at the Hanford Site. Primary contaminants of concern in the groundwater include chromium, ^{90}Sr, and ^{3}H. Some operable units are of high priority because these sites have released radioactive and hazardous substances to the environment, i.e., the Columbia River.

Depending on the lead regulatory agency and/or the type of waste site, each operable unit has been designated to be characterized and remediated under the *Comprehensive Environmental Response, Compensation, and Liability Act of 1980* or RCRA site restoration process.

Site restoration is initiated with the preparation of a work plan that lays out the plans for the first phase of characterization and the initial screening of remedial alternatives. Upon completion of the first phase of characterization, a supplemental work plan is prepared to plan any additional characterization activities and make the final remediation choice. The overall process results in a record of decision issued by the lead regulatory agency. Upon approval of the record of decision, the remedial action design can be initiated, followed by the remediation.

The work plans for many of the operable units are under way now. Completion of remedial investigation/feasibility study for most of the sites is not anticipated until the year 2005.

Sampling needs for the operable units consist of the need for assessment and characterization of the contamination in, around, and beneath the units. Upon approval of the work plans, sampling and analysis will occur on and beneath the operable unit including the surface, vadose zone, and the groundwater. After sufficient information has been collected and analyzed to describe the extent of the contamination, remediation alternatives will be analyzed and a proposed plan will be submitted for remediation activities.

B.5.2 Sample Projection

The Soil Remediation Program is estimated to yield approximately 600 samples exceeding 10 mrem/hour during this plan period. An additional 6,600 samples measuring less than 10 mrem/hour will be collected and analyzed offsite. The basis for this estimate is an assumption that an average of two boreholes will be made at each site. The borehole depth will average 30 m (100 ft) with continuous sampling in 61-m (2-ft) segments for a total of 50 samples per hole. Approximately four samples from each borehole will exceed 10 mrem/hour.

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It is further assumed that there are two "hot" sites for each of the nine production reactors (18 sites), four "hot" sites in the 300 Area and ten "hot" sites resulting from operation of each of the five production facilities (T Plant, B Plant, PUREX, PFP, and REDOX), which yields 50 sites and a grand total of 72 sites.

B.6 HANFORD WASTE VITRIFICATION PLANT

B.6.1 Program Description

The Hanford Waste Vitrification Plant will immobilize pretreated high-level and transuranic waste currently stored in underground DSTs at the Hanford Site. The plant will process the waste into a borosilicate glass waste form and temporarily store it in stainless steel canisters until shipment to an offsite Federal geologic repository. Detailed design activities began in January 1990.

A risk assessment began in October 1990 to assess and quantify technical, regulatory, and programmatic risks to the pretreatment and vitrification of tank wastes at the Hanford Site. This assessment is a comprehensive compilation of risks and potential impacts that are being modeled and statistically analyzed to determine the probability of success of disposal activities.

B.6.2 Sample Projection

Waste tank core samples are not planned in all cases to be taken specifically to support the Hanford Waste Vitrification Program; however, additional analyses will be performed on samples produced by other programs to meet Hanford Waste Vitrification Plant needs. In Table 1-1, AEU Factors, and Table 1-2, Projected Program Analytical Needs, HWVP is included under nonwatchlist DST liquid and solid samples.

B.7 SOLID WASTE CHARACTERIZATION

B.7.1 Program Description

The retrieval facilities will exhume the drums and boxes from storage; package them for shipment; provide an approximation of fissile contents via fixed or portable assay equipment; identify the package by bar code; provide manifests for the packages; and vent containers, sample head gases, and install filters.

B.7.2 Sample Projection

At this time there is no plan to modify the 222-S Laboratory of the PNL Analytical Chemistry Laboratory to accept a large volume of transuranic wastes; therefore the alpha needs for the Solid Waste Characterization program includes only a small number of AEUs for investigative and process development work.

B.8 WASTE RECEIVING AND PACKAGING

B.8.1 Program Description

The Waste Receiving and Packaging Facility will have the capability to certify retrieved and newly generated drummed contact-handled transuranic waste and low-level waste. The facility will include nondestructive assay/nondestructive examination equipment that will detect suspect noncompliant items. This equipment is capable of determining the fraction of transuranic waste that meets the criteria of low-level and transuranic waste. There will be an open sort area where noncompliant items that will not meet the Waste Isolation Pilot Plant acceptance criteria can be removed. The facility will be configured to allow loading of contact handled transuranic waste into TRUPACT-II shipping containers and will be able to certify newly generated small boxes of transuranic waste. Module 1 will not handle large boxes of retrieved waste. The assay capabilities of Module 1 will replace those currently in the Transuranic Waste Storage and Assay Facility.

B.8.2 Sample Projection

A large volume of transuranic waste analysis is projected to support the Waste Receiving and Packaging Facility starting in 1997. This analytical load is not included in this evaluation because there is no plan to characterize this waste in the 222-S Laboratory or the PNL Analytical Chemistry Laboratory. A small number of AEUs were included before 1997 for process development work.

B.9 STABILIZATION AND ISOLATION

B.9.1 Program Description

Stabilization and isolation provides for the interim treatment of SST waste for the Tank Farm Operations and Maintenance. This includes interim stabilization of SSTs by removing approximately 19,000,000 L (5,000,000 gal) of residual liquid from 44 SSTs; isolating 52 SSTs to meet milestones in the Tri-Party Agreement; and emergency pumping of suspected leaking SSTs.

B.9.2 Sample Projection

Characterization planning in support of stabilization and isolation shows 22 SSTs being sampled in 1992 and 18 SSTs per year in the following 3 years. Two samples are taken from each tank for a total of 152 samples. Not all of the samples will be necessary, however, because SST characterization core analyses results can be used if scheduled ahead of the Stabilization and Isolation activities. Taking SST characterization into account, a total of 12 AEUs is estimated over a 4-year period.

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APPENDIX C

LABORATORY FACILITIES

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LABORATORY FACILITIES

There are two primary analytical laboratory facilities at the Hanford Site, the 222-S Analytical Laboratory and the Pacific Northwest Laboratory (PNL) Analytical Chemistry Laboratory. The 222-S Analytical Laboratory is used to support the analytical needs for the operating plants at the Hanford Site. This laboratory conducts routine analyses on a multiple shift schedule. The PNL Analytical Chemistry Laboratory is used to support the multitude of small programs being conducted at the PNL and Westinghouse Hanford Company (Westinghouse Hanford). Much of the work done in these hot cells associated with these laboratories is related to process development and characterization of waste management systems.

C.1 PACIFIC NORTHWEST LABORATORY ANALYTICAL CHEMISTRY LABORATORY

The PNL Analytical Chemistry Laboratory (ACL) organization has primary responsibility to provide analytical chemistry support to a wide spectrum of Hanford Site programs. Support is provided to multiple research and development programs, to several aspects of Fast Flux Test Facility operation, to site environmental and safety monitoring programs, to tank characterization and safety investigations, and to the Hanford Site environmental restoration activities. Analytical chemistry activities cover a broad spectrum of program and analysis requests and range from semi-routine analyses for all sample types to the development and application of state-of-the-art chemical analysis instrumentation. Laboratory staff and equipment are housed in several buildings within the 300 Area--325, 329, 314, and 3708. Organizationally, the ACL is divided into five Technical Groups, the Analytical Laboratory Operations Section, and the Production Planning and Control Section.

One of the Technical Groups is the Shielded Analytical Laboratory, a set of six hot cells designed specifically for the performance of analytical chemistry activities on highly radioactive samples. Operations performed in these cells generally involved steps to prepare hot samples for solubilization, sub-sampling, and removal from the hot cells for distribution to other Technical Groups for further chemical analysis. The facility (often termed the "325 B Hot Cell Facility") will be a critical processing point during the chemical analysis of hot samples from the Hanford waste storage tanks and highly radioactive operable units.

Other groups include Radioanalytical, Inorganic Analysis, Organic Analysis, and Advanced Inorganic Analysis. All of these groups perform semi-routine analyses and are also involved in methods development activities for unusual sample types. Organic and Inorganic group staff members participate in the periodic analysis of U.S. Environmental Protection Agency performance evaluation samples. Radioanalytical group members participate in the U.S. Department of Energy EML performance evaluation program. The Advanced Inorganic Analysis Group represents the only Hanford Site laboratory to have received accreditation by the Washington State Department of Ecology.

Total radiochemical, inorganic, and organic analysis capabilities reside within the Analytical Chemistry Laboratory, including the ability to prepare all data packages to U.S. Environmental Protection Agency Contract Laboratory Program standards. Data package preparation for very large programs (eg., SST Characterization, 200-BP-1 OU) is performed with the assistance of staff of the Analytical Laboratory Operations (ALO) Section. Staff in this section are responsible principally for program and data management. Many of the ALO staff function as the primary interfaces between the ACL chemistry staff and the WHC program staff for major programs.

The Production Planning and Control (PP&C) Section retains the authority and responsibility for accepting, scheduling and statusing the analytical workload within the ACL. Its role begins in the proposal, or planning stages, of an analytical effort. Coordinating the planned analyses to be compatible with ACL Technical Group capabilities and capacities and inter-group work flow dependencies provides assurance that commitments will be met. Analyte-specific process flow networks enable the identification of laboratory capacities as well as providing the bases for cost/schedule control systems applications at the project level. Another functional responsibility of the PP&C is the development (or acquisition) and implementation of those management systems that provide the requisite visibility and control of the overall workload. Presently, an internally developed system that was designed for sample receiving control is being extended to provide work-in-process visibility, pending receipt of funds for a Laboratory Information Management System (LIMS). It is also within the scope of this organization to define and implement, coordinating with Westinghouse Hanford Company for commonality where possible, the LIMS as it will be applied within the ACL. Completed project files are retained and controlled by PP&C records management staff. Finally, the ACL's commitment to client-responsive and scientifically defensible analytical data is affirmed by an independent Quality Control function appointed to this section, whose purview includes Performance Evaluation sample management, data review and verification, quality control practices, standards laboratory oversight, and representation to regulatory agencies in laboratory certification endeavors.

C.2 222-S LABORATORY

The 222-S Laboratory is Westinghouse Hanford's primary laboratory. It comprises about 70,000 ft^2 of laboratory space containing about 150 hoods, and analytical hot cell space that uses 12 remote manipulators. Laboratory facilities include four hot cells. Each hot cell is equipped with manipulators and hoists for remote handling, leaded glass windows for observation, and transfer drawers and/or pass-throughs that provide for input and removal of sample equipment and waste. The four analytical hot cells in the 222-S Building have been used to provide analytical chemistry support for Hanford Site processing plants; initially for the Redox Plant in the 1950s and later including PUREX, Plutonium Finishing Plant (PFP), B Plant, Waste Encapsulation and Storage Facility, the Grout Program, and the 242-A and 242-S Evaporators. Support has also been provided to the tank farms.

The 222-S Laboratory supports all activities in the 200 Areas in some manner. Samples are analyzed for environmental and effluent monitoring, chemical processing, and waste management activities. Analyses of environmental, effluent, process chemical, and nonroutine samples are conducted on the day shift. Wet-chemical and radioactive analyses are carried on during off-shifts to support waste management activities. Environmental and effluent samples include liquid effluents, ground and surface waters, soil, animals, vegetation, and air filters.

Present activities include continuing analysis of Tank Farm process control samples, and continued analysis of grout formulation and process control samples. Analytical support for Phase IC of the Single-Shell Tank (SST) Characterization Program was started in fiscal year (FY) 1991.

Past waste tank support work includes waste sampling before discharge to waste tanks, tank farm process control samples, and Phase IA and IB trial runs of the SST Characterization Program. Examples of past process support activities include sample analyses for the Waste Encapsulation and Storage Facility cesium and strontium encapsulation processing, and development for grout formulation activities.

C.3 METALLURGICAL HOT CELLS

Hanford Site metallurgical cells are located in two 300 Area buildings. The Fuels and Materials Examination Facility (FMEF) located in the 400 Area is also grouped with the metallurgical hot cells because of its initial design purpose. The layout of the FMEF cells is quite flexible however, and they can be adapted to other uses including chemical processing. Past and present activities are summarized.

C.3.1 324 Building Shielded Materials Facility

The three Shielded Materials Facility cells in the 324 Building have been used in support of fuel and structural material development programs for power and test reactors. Activities included nondestructive examination (visual, profilometry, gamma scans) of irradiation experiments, material property tests, and processing (disassembly and assembly) of structural material experiments (e.g., Fast Flux Test Facility materials open test assembly). Experiments were remotely assembled for irradiation in the Transient Reactor Test Facility and the Experimental Breeder Reactor No. 2 at Idaho National Engineering Laboratory. Recent activities include the examination of the Waste Encapsulation and Storage Facility cesium chloride capsules in a compartment within one of the cells. An ongoing activity is the handling of offsite shipping casks (unloading, transfer of payloads, loading, shipping, etc.).

The facility (south cell) is presently being configured to fabricate cesium chloride capsules for irradiators. Four compartments (containment to confine cesium chloride contamination) within the south cell will be equipped for the fabrication process. Examination of Waste Encapsulation and Storage Facility cesium chloride capsules will also continue in one of the compartments. An exhaust system (compartment negative pressures) will be installed to keep the cesium contamination localized. The remainder of the south cell will be used to process structural material experiments and conduct material property tests (tensile and compact tension). The east cell will be configured for processing of tritium target experiments that will include gas collection and analysis. Equipment in the east cell for profilometry and gamma scanning will remain operational.

C.3.2 327 Postirradiation Testing Laboratory

The 327 Postirradiation Testing Laboratory provides shielded, ventilated, and specially equipped laboratories for physical and metallurgical examination and testing of irradiated fuels, concentrated fission products, and structural materials. The examination and testing are carried out in 12 shielded cells equipped with viewing windows, manipulators, and required machinery. One of the cells has an inert nitrogen atmosphere for the examination and testing of materials that would be adversely affected by an air atmosphere. The remaining cells have an air atmosphere. In addition, the building has a low-level waste compaction station used to compact waste generated in the 327 Building and waste from other 300 Area buildings.

The 327 Laboratory also has 810 three-in.-square by eight-in.-deep shielded storage spaces for high dose rate radioactive materials. These spaces can hold up to 7 g of fissile material each, while the entire facility can handle 600,000 Ci. A cask unloading cell complete with small shipping casks and a transfer cask to move materials from the unloading cell to the storage location is also available.

C.3.3 Fuels and Materials Examination Facility

The FMEF is a new, never-commissioned hot cell facility designed to support the nondestructive and destructive examination of liquid metal fast breeder reactor fuel. The FMEF is the most up-to-date and modern hot cell facility at the Hanford Site and complies with all pertinent design requirements established in DOE Order 6430.1A *General Design Criteria* (DOE 1989). The FMEF hot cell facility is comprised of 17 hot cells totaling 9,393 ft^2, with the largest cell having 4,000 ft^2 and the smallest having 39 ft^2.

C.4 324 BUILDING A-, B-, C-, AND D-CELLS

The radiochemical engineering cells in the 324 Building have been used to develop and demonstrate technology to treat high-level nuclear waste for its ultimate disposal. In the mid-1980s, a continuous process was demonstrated in B-Cell for incorporating high-level waste into a borosilicate glass using a radioactive liquid-fed ceramic melter. Using the B-Cell radioactive liquid-fed ceramic melter, 30 canisters of radioactive waste containing glass were prepared in the late 1980s. The canisters were 8 in. in diameter by 4 ft long, and were filled with borosilicate glass containing a total of 4.8 MCi of ^{137}Cs and 3.6 MCi of ^{90}Sr. A-Cell was used to decontaminate the canisters by electropolishing.

At present, the cell complex is being cleaned out, upgraded, and restored to an operation-ready, standby, or decommissioned status depending on future DOE needs for hot cell facilities. C-Cell has been restored and is in operation for size-reducing targets activated in a Savannah River reactor. B-Cell is under restoration, and restoration of D-Cell has started. A-Cell restoration is expected in FY 1993.

APPENDIX D

CHARACTERIZATION REQUIREMENTS

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CHARACTERIZATION REQUIREMENTS

The *Waste Characterization Plan for the Hanford Site Single-Shell Tanks* (WHC 1991b) is based on requirements for a waste analysis plan for characterizing hazardous waste under the *Resource Conservation and Recovery Act of 1976* and the *Washington State Hazardous Waste Management Act* and for characterizing radioactive waste under the *Atomic Energy Act*. The waste characterization plan represents an all-purpose plan to identify analysis requirements for regulatory, performance assessment and technology, and process development purposes.

The single-shell tank (SST) waste characterization program is being conducted by Westinghouse Hanford Company (Westinghouse Hanford) for the U.S. Department of Energy (DOE). The waste characterization program includes several objectives.

- Obtain information so the waste can be handled properly to ensure protection of human health and the environment.
- Support regulatory requirements for waste analysis.
- Classify the wastes based on criteria such as dangerous waste and extremely hazardous waste content, radioactive constituent content, and water content to assist in determining the statutory and regulatory requirements that must be met by a chosen disposal option for the wastes. Initially (Phase IA, IB) the waste will be classified through evaluation of sampling and analysis for specific parameters and performance of characteristic and criteria testing. Results from these tests and development tasks will be used to define the testing program for Phase IC.
- Obtain sufficient information about the chemical, radioactive, and physical properties of the wastes to support technology development, a supplemental environmental impact statement, and closure plans. The intent is to make disposal decisions based upon health and safety considerations, performance assessments, and regulatory, institutional, and technology-based criteria that will protect human health and the environment.

The first phase of the two-phase characterization program will sample and analyze all 149 SSTs to provide data to (1) develop technologies for waste retrieval, pretreatment, and treatment; (2) prepare a supplemental environmental impact statement; (3) prepare SST closure plans; and (4) make a preliminary sorting of tanks based on their hazard to human health and the environment (a sorting of those tank wastes most likely to be disposed of in place to those most likely to be retrieved for geologic disposal). Phase II of the characterization program will collect data to support in-place disposal assessments for certain wastes and to implement disposal decisions.

The composition of the SST wastes, which contain both radioactive and chemically hazardous constituents, is complex and uncertain. A complete understanding of the information needed to evaluate disposal options for the SST wastes is not yet possible. However, it is recognized that information needs fall into four categories: information needed to (1) address regulatory requirements, (2) conduct performance assessments, (3) develop and evaluate technologies, and (4) determine waste characteristic distributions.

D.1 REGULATORY-BASED INFORMATION NEEDS

Regulatory-based information requirements will be important in determining which options for disposal of the SST waste meet current regulatory requirements. The disposal of chemically hazardous and radioactive wastes is governed by different sets of regulations. These regulatory distinctions can create uncertainty about how to manage or dispose of mixed waste. Often, regulations that cover hazardous wastes do not address the complications of radioactivity. Similarly, regulations governing radioactive waste disposal were not written to account for a variety of independently hazardous chemical substances. In addition, the SST wastes represent a complex mixture of wastes resulting from numerous facilities and processes rather than from a single generating source. Thus, the application of regulations governing radioactive and chemically hazardous waste to the SST waste is not straightforward.

Regulatory-based information needs are addressed by determining which waste constituents and parameters are of regulatory importance under key statutes and regulations relating to hazardous and radioactive waste disposal and environmental pollution control. These constituents and parameters include those used to designate the SST wastes as dangerous waste, extremely hazardous waste, or not regulated under the Washington State *Dangerous Waste Regulations* (Ecology 1989). These constituents and parameters are then evaluated for the feasibility of obtaining meaningful waste analysis data. Data that support regulatory-based information needs will be collected during both Phase I and Phase II waste characterization. Sufficient information will be obtained to manage the waste properly to prevent a threat to human health and the environment.

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D.2 PERFORMANCE ASSESSMENT

Performance assessment requires information on the physical, chemical, and radiological characteristics of the waste, as well as environmental data and other factors affecting contaminant release and transport. The constituents of greatest interest are those that are released in sufficient quantity, are sufficiently mobile, and are sufficiently toxic to pose a risk to human health and the environment.

Disposal decisions will be ultimately based on comparative technology evaluations and applicable regulatory requirements. In these evaluations, consideration will be given to the performance of retrieval, pretreatment, and treatment technologies and the impacts on human health and the environment of various disposal options. These evaluations, to be conducted at the end of Phase II in the context of the supplemental environmental impact statement, will use performance assessment computer codes and the SST inventories determined during characterization. In addition, performance assessments may be required subsequent to completion of the supplemental environmental impact statement to address compliance with regulatory-based performance requirements. Final disposal decisions will address regulatory-based performance requirements and will be documented and submitted for approval in the SST system closure and post-closure plans in accordance with applicable regulations.

In the interim, performance assessment studies will be used to support preliminary technology evaluations and to aid in the design of the characterization program. Because it is not feasible to test the SST wastes for all potential constituents, preliminary performance assessment studies will be conducted before and during Phase I characterization to (1) help identify the constituents that are of most concern from a risk standpoint and (2) provide the preliminary grouping of SSTs at the end of Phase I.

Characterization of the environmental setting for SSTs and model development efforts to refine the performance assessment codes will also continue during Phases I and II; however, such activities will be addressed separately in other documentation.

D.3 TECHNOLOGY EVALUATION AND DEVELOPMENT

During SST characterization, data must be obtained that will facilitate the evaluation and development of technologies for retrieval of wastes from the SSTs, immobilization and in-place disposal of the waste form, pretreatment of retrieved wastes before disposal, and immobilization of pretreated waste for disposal. For example, both the physical characteristics of the waste and integrity of the tanks will determine whether waste retrieval or in-place disposal schemes are feasible or whether additional methods must be developed. Other characteristics will be important in the evaluation and development of specific treatment and pretreatment processes for technologies such as grouting or vitrification that may have design constraints on the type and amount of particular components in the feed streams. Almost all of these constraints can be accommodated by proper pretreatment.

Data to support technology evaluation and development will be collected during both Phase I and Phase II. Pretreatment and treatment studies have recently been initiated that will refine the associated inventory-related data requirements during waste characterization.

D.4 WASTE CHARACTERISTIC DISTRIBUTION

If data on the location of a waste parameter or characteristic within an SST is required, samples will be analyzed differently than for the cases in which such data are not required. A tank "core sample" refers to the entire sample of waste taken from the top to the bottom of the tank. A tank core sample is obtained by taking multiple core "segment samples" until the entire depth [except for the bottom 7.62 cm (3 in.) of waste] of the core sample has been obtained. The average tank core sample contains five 48-cm- (19-in-) long waste segments; each sample segment contains about 250 mL (8.45 fl oz) if a full segment is obtained. The amount of waste (depth) in the tanks varies from a few centimeters to 879 cm (346 in.), and a core may contain from 1 (partial) to 19 segments.

Tests will be run on homogenized segments, core composites, tank composites, or tank farm composites depending on the need for distributional or inventory-type data. Core composites are prepared by combining and homogenizing waste material from all segments in a core sample and are used to obtain inventory and horizontal distribution information. Tank composites are prepared by combining and homogenizing waste material from all segments of the two core samples obtained from each tank. Occasionally, tests may be run on tank farm composites that are prepared by combining and homogenizing tank composites from all tanks in a tank farm.

Some physical and organic tests must be run on waste segments as they are received, before any homogenization is performed, because the homogenization process will alter the physical nature and volatile component (e.g., organics, water) concentration in the sample. As currently designed, the waste characterization plan includes the analysis of segments for some chemical, radiochemical, and physical parameters but not for all individual constituents. Phases IA and IB will be used to evaluate the vertical distribution of selected waste components. Vertical distribution of components will be determined by analyzing homogenized segments. Evaluation of segment analyses and visual observations of the segments will be used to identify stratification in the wastes. Data from vertical distribution studies in Phases IA and IB will be evaluated to determine the vertical distribution analysis plan for Phase IC.

D.5 SINGLE-SHELL TANK CHARACTERIZATION

The *Waste Characterization Plan for the Hanford Site SSTs* (WHC 1991b) is intended to be a "living document" in that as more knowledge is gained through characterization efforts, that information will be used to revise the plan. The brief description of some areas associated with sampling requirements are included in this section.

Waste characterization has been divided into four process categories of work that must be performed on a core sample from a tank for the purpose of analyses. The process categories are:

1. Tank sampling

2. Segment receipt and handling (at the laboratory)

3. Sample transfer (from hotcell to hood, where appropriate)

4. Sample analysis.

The sort on radioactive waste type model has been developed to categorize SSTs into groups expected to exhibit similar chemical and physical characteristics based on major waste types and processing histories identified from historical records. This method has identified 29 different groups of tanks. These 29 groups encompass 131 tanks and 90% of the total waste volume contained in SSTs. The 18 remaining SSTs were not predicted to fall into any group and were encompassed in a 30th ungrouped category. The model has been used to determine tank selection and order for sampling and analysis.

D.5.1 Program Description

The 200 East and 200 West Areas of the Hanford Site contain 149 underground SSTs. Each SST contains radioactive wastes that are a result of previous chemical processing operations. The SST waste is of varying quantity and composition. Currently, final disposal options for these SST wastes include both permanent in-place stabilization and/or isolation and recovery of tank contents for further processing and disposal. Environmentally acceptable methods of conducting either of these alternatives require adequate characterization of the SST wastes.

Final disposal options for the SST wastes must address both radioactive and chemical waste hazards and must be consistent with federal and state guidelines. An essential step in the development of an appropriate final disposal option for the SST wastes is their characterization. Characterization of SST wastes is defined as the determination of the concentrations and total quantities of specified radionuclides and selected chemical species of the wastes stored in SSTs.

During the 36 years the SSTs were in service, the contained wastes were intermixed, concentrated, scavenged, and pretreated to remove long-lived fission products. Therefore, the contained radioactive and hazardous waste content of each tank is not well known. Multiple representative samples must be obtained from each tank in order to develop data for the following:

- Support the timely development of tank waste in-place disposal and/or retrieval technology.
- Assist in preparation of the supplemental environmental impact statement (for determining final disposal or remediation of SST wastes).
- Prepare a SST system closure and/or postclosure plan.

Sampling the contents of the SSTs is a complex process because of the radioactive and hazardous nature of the waste, as well as the complexity of the equipment. Under the requirements of the *Hanford Federal Facility Agreement and Consent Order* (Tri-Party Agreement) (Ecology et al. 1990), sampling will involve the removal of at least two core samples from each of the 149 SSTs.

The *Waste Characterization Plan for the Hanford Site Single-Shell Tanks* (WHC 1991b) is based on requirements of the *Resource Conversation and Recovery Act of 1976* and the State of Washington *Dangerous Waste Regulations* (Ecology 1989), and incorporates the requirements used for characterizing radioactive waste under the *Atomic Energy Act*. The Waste Characterization Plan represents an all-purpose plan to identify analytical requirements for regulatory performance assessment and technology as well as some process development.

The waste characterization plan, in progress since 1989, has two phases, each with subphases. Phase I was to have (1) tested laboratory systems for receiving, preparing, and analyzing SST samples, (2) evaluated homogenization and composite procedure variability, (3) included sampling and analysis to

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estimate sampling reproducibility and evaluate potential bias caused by using existing tank risers, and (4) determined the vertical distribution of selected waste components, identified waste strata, and provided inventory estimates. Phase II will collect data to support in-place disposal assessments and to implement disposal decisions.

The verification and preparation of data packages for Phase IA and IB analysis has taken longer than anticipated. The original purpose of the program was to issue a generic Phase IC waste analysis plan for the remaining SSTs. Although completion of a generic Phase IC waste characterization plan will not be possible until all the Phase IA and IB information has been analyzed, development and initiation of limited Phase IC sampling and analysis can proceed. The characterization goals and strategies will be iterated based upon new analytical results from each SST sampled.

The U.S. Environmental Protection Agency has defined data quality objectives, which assist in defining the type, quality, and quantity of the data needed to evaluate waste sites, or in this case, SSTs. Analyte priorities and proposed detection limit goals (based upon the concentration threshold concept) are preliminary data quality objectives that have been developed for the SST waste characterization effort based upon health risk and regulation criteria.

Three different methods were used to prioritize the SST analytes: Long-term release risk, short-term intruder risk, and waste classification. Each of these three methods produced a list of prioritized SST analytes that could be used, independently or combined, to improve the design of the SST waste characterization plan. A combined analyte priority list, based upon the highest relative risk or waste class type for each analyte (Type I analytes are more significant than Type II analytes) from the three methods, was used to define Type I, II, and III analytes in the *Waste Characterization Plan for the Hanford Site Single-Shell Tanks*, Appendix I, "Test Plan for Sampling and Analysis of Ten Single-Shell Tanks" (WHC 1991b).

The primary objective of the sampling and analysis plan is to obtain estimates of the total quantity of Type I and Type II analytes in each SST sampled. These inventory estimates are essential for making risk assessment-based disposal decisions and for the design of pretreatment and final waste-disposal systems. The analytical data necessary to estimate the constituent inventories will be collected by obtaining at least two cores from two different risers in each SST and compositing representative portions of each homogenized 48 cm (19 in.) segment. Aliquots will be taken from each homogenized core composite and will be analyzed in the laboratory for Type I and II analytes and for other compounds of regulatory concern.

Additional analyses will be conducted to measure physical properties of the waste to support waste-retrieval technology development, determine waste designation, determine vertical and horizontal spatial variations, and tank stability along with other analyses.

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