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Maintenance Plan for the Composite Analysis of the Hanford Site, Southeast Washington

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Summary

Previous U.S. Department of Energy (DOE) Order 5820.2a and new DOE Order 435.1 on radioactive waste management require that site performance assessments and composite analyses be maintained by the Hanford Site. This document describes the plan for maintaining a Composite Analysis that will support waste disposal and remedial actions for the Hanford Site. An initial Composite Analysis of the site, *Composite Analysis for Low-Level Waste Disposal in the 200 Area Plateau of the Hanford Site*, was issued in 1998[1] and has been recently approved.[2] This document meets the maintenance plan requirements described in Order 435.1 and implements the requirements of the Disposal Authorization related to the Composite Analysis[3] for the Richland Operations Office, the responsible field office, and its contractors.

In addition to providing current plans for revisions to the Composite Analysis, this document describes the expected work on ongoing reviews of new information and data related to site residual sources of radioactive material, land use, monitoring, and research and development-related activities being conducted at Hanford and within other DOE programs.

The main emphasis of the current plan is to identify additional data and information that will better support the analyses in the current Composite Analysis and the amendment that will be prepared and submitted in FY 2001. Improvements are expected in the knowledge of waste characterization and inventory, site-specific geotechnical data, and final disposition of major disposal facilities and waste sites.

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[1] Kincaid, C. T., M. P. Bergeron, C. R. Cole, M. D. Freshley, N. L. Hassig, V. G. Johnson, D. I. Kaplan, R. J. Serne, G. P. Streile, D. L. Strenge, P. D. Thorne, L. W. Vail, G. A. Whyatt, S. K. Wurstner. 1998. *Composite Analysis for Low-Level Waste Disposal in the 200-Area Plateau of the Hanford Site*. PNNL-11800, Pacific Northwest National Laboratory, Richland, Washington.

[2] U.S. Department of Energy (DOE). 1999f. Letter from J. Fiore (Acting Deputy Assistant Secretary for Environmental Restoration) and M. Frei (Acting Deputy Assistant Secretary for Waste Management) to Manager for Hanford Office of River Protection and Manager for Richland Operations, "Conditional Acceptance of the Immobilized Low-Activity Tank Waste Disposal Facility Performance Assessment and the Hanford Site 200 Plateau Composite Analysis," U.S. Department of Energy, Washington, D.C., dated October 20, 1999.

[3] U.S. Department of Energy (DOE). 1999g. "Disposal Authorization Statement for the Department of Energy Hanford Site Low-Level Radioactive Waste Disposal Facilities," attachment to the letter from C. L. Huntoon (Assistant Secretary for Environmental Management, U.S. Department of Energy) to J. T. Conway (Chairman, Defense Nuclear Facilities Safety Board), U.S. Department of Energy, Washington, D.C., dated October 25, 1999.

Acronyms

ALARA	As Low as Reasonably Achievable
CA	Composite Analysis
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
DOE	U.S. Department of Energy
EDE	Effective Dose Equivalent
EIS	Environmental Impact Statement
ERDF	Environmental Restoration Disposal Facility
EMSP	Environmental Management Science Program
ERC	Environmental Remediation Contractor
GW/VZ	Groundwater/Vadose Zone
LFRG	Low-Level Waste Disposal Facility Federal Review Group
ILAW	Immobilized Low-Activity Waste
NEPA	National Environmental Policy Act
ORP	Office of River Protection
PA	Performance Assessment
RCRA	Resource Conservation and Recovery Act
RL	Richland Operations Office
ROD	Records of Decision
SAC	System Assessment Capability
TWRS	Tank Waste Remediation System

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1.0 Introduction

1.1 Background

U.S. Department of Energy (DOE) Order 5820.2a and newly issued Order 435.1 (DOE 1999a) and its associated manual (DOE 1999b) set the radioactive waste management requirements for operations DOE undertakes. Chapter 4 of the manual sets the requirements for the creation and maintenance of documents (known as a performance assessment [PA] and a composite analysis [CA]) that analyzes the long-term effect of disposing of low-level waste. DOE has also issued guidance on the manual (DOE 1999c) and a guide dealing solely with the maintenance of PAs and composite analyses (DOE 1999d).

1.2 Key Findings of the Composite Analysis

This section of the plan discusses the results of the Composite Analysis compared to the primary dose limit and the dose constraint. It includes discussions of the principal sources of uncertainty and their implications for the primary results of the study.

The Composite Analysis documented in Kincaid et al. (1998) was a first attempt at Hanford to estimate the cumulative impacts of radiological sources in the 200 Area Plateau. The study objective was to assess cumulative dose impacts to hypothetical future members of the public in an accessible environment postulated between the 200 Area Plateau and the Columbia River during the 1000 years after projected site closure in 2050.

Estimating dose was a multi-step process involving:

- **Inventories** - Estimation of radiological inventories and releases for 241 unique source sites to the environment

- **Environmental Pathways** - Assessment of contaminant migration through the vadose zone, groundwater, and atmospheric pathways

- **Contaminant releases** - Most mobile radionuclides were considered. The vadose zone and groundwater pathway considered carbon-14, chlorine-36, iodine-129, selenium-79, strontium-90, technetium-99, tritium, and uranium Isotopes. The atmospheric pathway examined carbon-14 and tritium. Most of the radionuclide inventory in past-practice liquid discharge sites and the pre-1988 solid waste burial grounds on the 200 Area Plateau would be released in the first several hundred years following Hanford Site closure. Previous releases are estimated to have occurred well before projected releases from active and planned disposals of solid waste, environmental restoration waste, and immobilized low-activity waste (ILAW).

- **Exposure Scenarios** - Estimation of doses for scenarios based on agricultural, residential, industrial, and recreational land use scenarios defined in DOE (1995a).

Results of the assessment showed that the maximum predicted agricultural dose outside the 200-Area plateau was less than 6 mrem in a year in 2050 and declined thereafter. This dose was primarily attributable to impacts from existing plumes of tritium and iodine-129. The maximum doses estimated for the residential, industrial, and recreational scenarios were 2.2, 0.7, and 0.04 mrem in a year, respectively, and also declined after 2050.

1.3 Interpretation of Results

The DOE primary dose limit of 100-mrem effective dose equivalent (EDE) in a year applies to a hypothetical future member of the public. This all-pathways dose to the maximally exposed offsite individual is calculated for 1000 years at points on the Hanford Site that a future member of the public could access. The future point of access nearest to waste disposal sites is defined by the boundary of a buffer zone designed to separate the public from the exclusive waste management area on the 200 Area Plateau (Figure 1.1). The dose constraint is defined as 30 mrem EDE in a year to the maximally exposed offsite individual for 1000 years (DOE 1996a) and is used to ensure that no single source, practice, or pathway uses an extraordinary portion of the primary dose limit. If the dose to the maximally exposed individual is above either 100 or 30 mrem in a year, an options analysis and an as-low-as-reasonably-achievable (ALARA) assessment must be performed to evaluate alternate actions the DOE could take to reduce the dose. If the dose is below 30 mrem in a year, a qualitative ALARA assessment should be performed to determine whether a quantitative ALARA analysis would be cost-beneficial.

To quantify potential impacts from alternate future land uses, four scenarios were used in the Hanford Site Composite Analysis to quantify dose to the hypothetical future member of the public. In order of significance by the dose they yield, they are based on agricultural, residential, industrial, and recreational land use assumptions. Each of these scenarios was applied to the region of the present Hanford Site outside the buffer zone surrounding the exclusive waste management area. Maximum dose within the exclusion area and buffer zone was not compared to the dose limit.

A review of existing radionuclide plumes in the unconfined aquifer revealed the presence of a strontium-90 plume beneath the decommissioned Gable Mountain Pond. The observed peak concentration of strontium-90 in the vicinity of the retired pond was 1500 pCi/L in 1996 (Hartman and Dresel 1997; Figure 6.10-10). Using the unit dose factor for strontium-90 from the agricultural scenario, this concentration in groundwater converts to a dose of ~470 mrem in a year. If the site is not remediated to remove the strontium-90 in groundwater and in the overlying vadose zone, it is recommended the exclusive waste management area be expanded to include this decommissioned pond. Furthermore, it is also recommended that a buffer zone of ~1000 m be established as a region of relatively clean groundwater surrounding the existing strontium-90 plume so monitoring can detect movement of the strontium. Strontium is highly sorbed on aquifer sediments (K_d = 20 mL/g), and its decay half-life is relatively short, 28.78 years. It is anticipated the declining water table will cause strontium in the upper sediments of the aquifer to be suspended in the vadose zone and thereby will further isolate the contamination. To simplify the discussion of results in the Composite Analysis, it is assumed the exclusive waste management area and buffer zone will be expanded as recommended. Hence, discussion of dose outside the buffer zone assumes the region surrounding Gable Mountain Pond is included inside the exclusive waste management area and buffer zone.

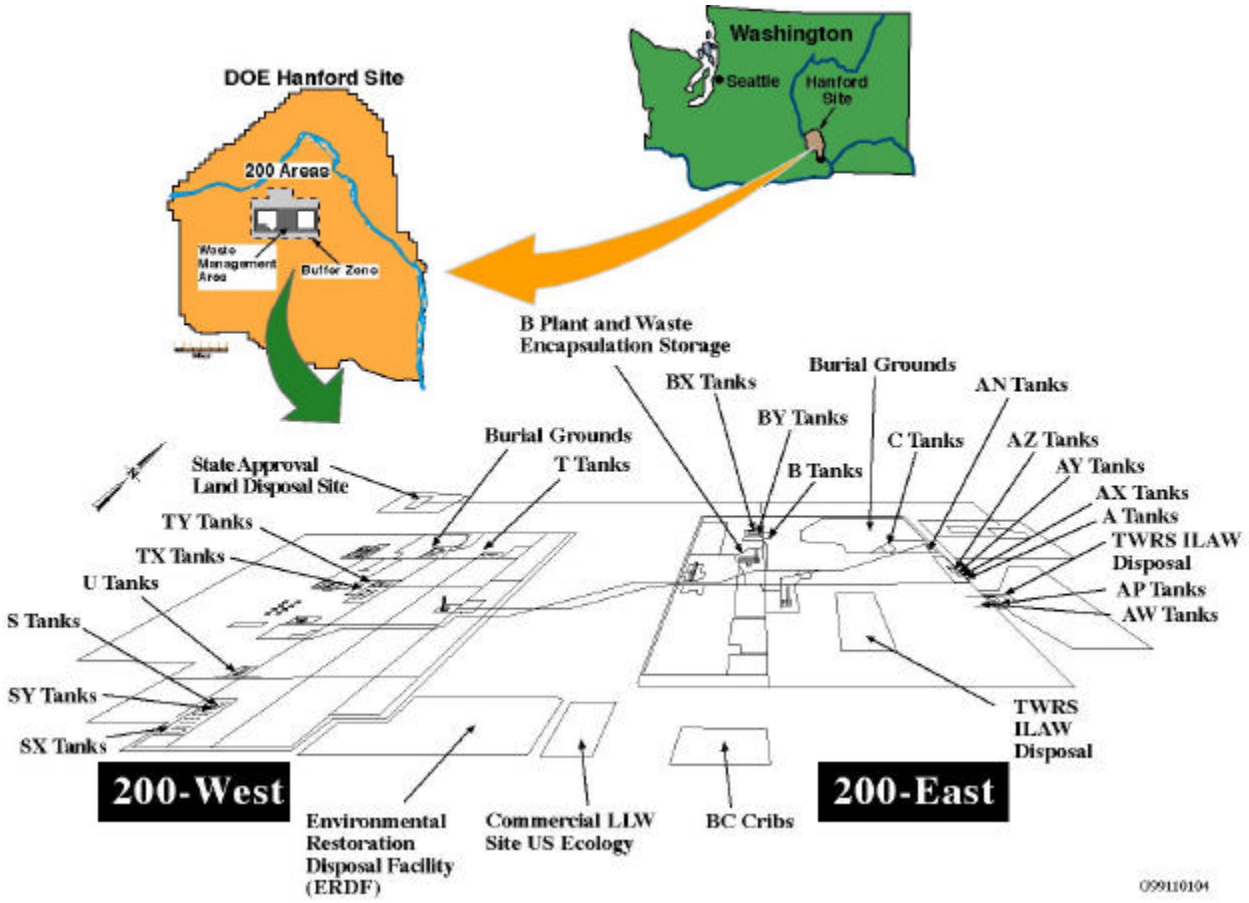

Figure 1.1. Buffer Zone, Exclusive Waste Management Area, and Key Waste Facilities and Sites In the 200 Areas at the Hanford Site

For the agricultural scenario, which exhibits the greatest dose, the maximum dose simulated from the cumulative releases is less than 6 mrem in a year during the regulatory period of 1000 years following Hanford Site closure for all lands outside the buffer zone. For this exposure scenario, the area extent of dose greater than 4 mrem in a year was projected to correspond with an area of 40 km^2 in the unconfined aquifer outside the buffer zone in 2050, when the Hanford Site is closed. The aquifer area outside the buffer zone associated with this level of dose is projected to vanish by 2085. Neither the primary limit, nor the dose constraint level, is exceeded. During the regulatory period of 1000 years following Hanford Site closure the maximum doses simulated for the other scenarios are residential, 2.2 mrem in a year; industrial, 0.7 mrem in a year; and recreational, 0.04 mrem in a year.

This analysis has shown that in the first 1000 years after Hanford Site closure, maximum dose to an individual outside the buffer zone occurs at the time of closure and diminishes thereafter. Current groundwater contamination and its corresponding dose are a result of liquid discharges and tank leaks to the subsurface. For the post-1988 solid waste burial grounds, an initial period of relatively high recharge (75 mm/yr) was assumed to apply until a surface barrier is constructed. Under this condition, releases to groundwater of the most mobile radionuclides (e.g., selenium-79, technetium-99) were simulated to occur

from the active and planned burial grounds in the next 200 years. However, sorbed radionuclides including carbon-14, iodine-129, and uranium (total) do not release in the 1000-year period. Dose at the boundary of the accessible environment (the buffer zone) resulting from releases from the post-1988 solid waste burial grounds, the Environmental Restoration Disposal Facility (ERDF), and the ILAW from Hanford Site tanks cannot be distinguished from background levels resulting from the earlier releases during the 1000-year period following Hanford Site closure.

Present calculated doses to a hypothetical onsite individual are the result of groundwater plumes originating from operational discharges that have been discontinued and early releases from accidental tank leaks. Secondary dose peaks occur in the 2020 to 2030 time frame. These secondary peaks are a result of the calculated breakthrough of radioactive contamination from accidental tank leaks, projected losses from single-shell tanks during future tank waste recovery operations, and early releases from solid waste burial grounds closed before September 26, 1988. At present, and for several years to come, doses calculated at points outside the exclusion area and buffer zone are dominated by tritium from past operations. By the assumed time of Hanford Site closure in 2050, doses are dominated by iodine-129 in the remnants of existing plumes.

The actual position and mobility of wastes in the vadose zone beneath liquid discharge facilities are not well known. Accordingly, analyses of liquid discharges to the aquifer are uncertain. However, existing groundwater contaminant plumes are a result of the past liquid discharges. Remnants of these wastes that remain in the vadose zone are deeper in the profile than dry wastes originally disposed in relatively shallow trenches. Many liquid wastes discharged to ground were very acidic or very basic waste streams; therefore, they may be under geochemical conditions more favorable for migration than neutralized solid waste in dry and relatively shallow disposals. Consequently, forecasts of relatively early releases from liquid discharge sites, past tank leaks, and losses during tank waste recovery operations are credible.

The analysis illustrates that, in comparison to the releases from liquid disposals or leaks, releases to the water table from the four active and planned low-level waste disposals will be delayed by hundreds or thousands of years. These disposals are essentially dry disposals. Releases from the ERDF and Tank Waste Remediation System (TWRS) ILAW disposal facilities do not release the most mobile radionuclides to the water table in the first 1000 years after Hanford Site closure. First releases of the most mobile radionuclides from the post-1988 solid waste burial grounds in the 200 West and 200 East Areas appear approximately 200 years after Hanford Site closure. Minimally retarded radionuclides, including iodine-129 (0.5 mL/g) and uranium (3 mL/g), do not release to the water table from the post-1988 solid waste burial grounds in the 1000-year period following Hanford Site closure. The maximum dose from these dry disposals to the hypothetical future member of the public in the accessible environment outside the buffer zone is indistinguishable from background values within the regulatory period.

This analysis concludes that releases from the four dry disposals do not present a significant impact to the health and safety of an individual outside the buffer zone during the 1000-year regulatory period. Consequently, the impacts of these disposals do not require completion of a quantitative options analysis and an ALARA assessment.

1.4 Related Hanford Site Activities

The Composite Analysis activity has relied on many programs at the Hanford Site to provide information useful to the Composite Analysis program. Among the most important of these are the other active assessment programs supporting the solid waste burial grounds, the ILAW disposal facilities and the ERDF. In addition, a series of other major assessments and data collection efforts are planned on the Hanford Site that should provide useful data to future iterations of the Composite Analysis. A brief description of these key projects is provided in the following sections.

1.4.1 Performance Assessments and Other Low-Level Waste Disposal Site Analyses

A number of PAs and other analyses have been developed at the Hanford Site to assess the long-performance of low-level waste disposal facilities including the solid waste burial grounds in the 200 East and 200 West Areas (Wood et al. 1996, 1994), the ILAW disposal facilities in the 200 East Area (Mann et al. 1997), and the ERDF (DOE/RL 1994) located between 200 East and 200 West Area. Following is a brief description of each of these assessments and their status.

1.4.1.1 Solid Waste Burial Grounds PAs

Two active PAs both deal with disposal in the low-level solid waste burial grounds in the 200 Areas: *Performance Assessment for the Disposal of Low-Level Waste in the 200 West Area Burial Grounds* (Wood et al. 1994) and *Performance Assessment for the Disposal of Low-Level Waste in the 200 East Area Burial Grounds* (Wood et al. 1996). DOE has approved both of these PAs (Cowan 1996, Frei 1997), and a single maintenance plan for these PAs has been created (Wood 1997). The solid waste performance assessment activity is sponsoring geochemical studies, work related to near-field releases and ongoing maintenance that are of particular interest to the Composite Analysis activity.

1.4.1.2 ILAW Disposal Facility Performance Assessment

DOE is currently storing about 210,000 m^3 (54 million gal) of high-level waste in 177 near-surface underground tanks in the central plateau area of the Hanford Site. DOE/BNFL (1998) intends to

- Retrieve this waste,
- Separate the waste into two streams (one containing the bulk of the waste and relatively few radionuclides – known as low-activity waste – and the other containing most of the radionuclides but consisting of little of the volume – known as high-activity waste)
- Immobilize both streams
- Store the immobilized high-activity waste onsite until it is transported to a federal repository and
- Dispose of the ILAW fraction in the central plateau of the Hanford Site.

To support the disposal of the ILAW, the *Hanford Immobilized Low-Activity Tank Waste Performance Assessment,* also known as the 1998 ILAW PA, was issued (Mann 1998). DOE HQ provided conditional approval of this document in 1999 (DOE 1999g), and hence, a maintenance plan for this PA has been prepared and approved by the Office of River Protection (Mann 2000).

1.4.1.3 Environmental Restoration Disposal Facility

The ERDF is the receiving facility for wastes generated by remediation of Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) past practice units at the Hanford Site. This disposal facility will receive remediation wastes expected to consist of hazardous/dangerous wastes, polychlorinated biphenyl (PCB) waste, asbestos waste, radioactive waste, and mixed waste (containing both hazardous/dangerous and radioactive waste). A large portion of the waste in the ERDF is expected to originate from areas along the Columbia River where it is anticipated that operable unit records of decision (ROD) will require excavation and removal of large volumes of remediation-generated wastes to the ERDF.

A remedial investigation/feasibility study (DOE/RL 1994) was completed to examine the impacts of construction and operation of the ERDF, which is located in the south-central part of the 200 Area plateau. A record of decision for initiation of disposal operations was completed in 1995 (DOE/RL 1995b). Approval of the Composite Analysis for ERDF as part of the disposal authorization stipulated the need for the ERDF to provide the DOE Office of Environmental Restoration with a crosswalk between the record of decision and the requirements outlined in DOE Order 435.1. The purpose of the crosswalk is to substantiate that the substantial requirements outlined in DOE Order 435.1 are fulfilled by the RI/FS analysis performed to support the ROD.

1.5 Other Major Assessments and Activities

The Hanford Site has produced a wide variety of documents estimating environmental impacts, including environmental impact statements (EISs) and remedial facility investigation reports. However, none of these activities maintains a continuously available capability to perform site-wide assessments. The projects and activities described below are expected future activities with which the Composite Analysis activity will interact.

1.5.1 System Assessment Capability

The Hanford Groundwater/Vadose Zone Integration Program (the Integration Program) was created to coordinate and integrate the various Hanford Site activities dealing with the vadose zone, groundwater, and river media that might be impacted by future Hanford Site operations (Bauer 1997). A major part of this program (DOE/RL 1999a) is the creation of a system assessment capability that can be used to estimate the cumulative impacts of all Hanford Site activities. This activity is expected to produce future versions of the Hanford Site Composite Analysis.

Composite Analysis staff are actively working with the System Assessment Capability staff to define and implement requirements needed to support future revisions to the Composite Analysis.

1.5.2 Tank Farm Vadose Zone Program

Some of the single-shell tanks that presently contain waste are known to have leaked to the vadose zone, and in some cases, are suspected to have reached the underlying groundwater. In addition, during the retrieval phase, additional waste may leak, and not all waste will be retrieved. The Tank Farm Vadose Zone Program is investigating the volume and inventory of past leaks, their environmental impact, and the impact of future losses during waste retrieval operations. Initially, the program will produce facility investigation reports and then remedial facility investigation reports. An EIS is expected to be created because tank closure was not addressed in the recent tank farm EIS (DOE/Ecology 1996). The Tank Farm Vadose Zone Program is also actively obtaining data concerning the impact of past tank waste leaks on the vadose zone.

The Composite Analysis activity will work closely with the Tank Farm Vadose Zone Program to understand the relevance of new data and information developed at tank farms to future revisions of the Composite Analysis.

1.5.3 ERC Activities

The Hanford Site Environmental Remediation Contractor (ERC) is responsible for closing most of the contaminated areas at the Hanford Site. This includes massive liquid discharges, solid waste landfills, and contaminated buildings and grounds. The present plan (DOE/RL 1999a) is to group the sites into a limited number (23) of waste groups and perform limited analysis on representative sites. The Composite Analysis activity will continue to work closely with the ERC activity and, in particular, the 200 Area Characterization project that is responsible for these activities in the 200 Areas.

The ERC is also responsible for remedial actions for all of the 100 Areas and the 300 Area. All CERCLA wastes from these cleanup actions are being disposed in the ERDF. The Composite Analysis activity will work through the ERC to understand their activities in these other Hanford Site areas that may be of importance to future revisions of the Composite Analysis.

1.5.4 Other Major Data Gathering Activities

As noted above, many of the assessment activities have associated data collection activities. The Composite Analysis activity itself is being conducted within the Hanford Groundwater Project (HGWP), which is a major Hanford Site data collection and interpretation activity focused on the groundwater system. This project collects, analyzes and interprets groundwater levels and groundwater quality samples from over 750 wells across the site. A summary of these data collection activities, which is published on an annual basis, provides a comprehensive interpretation of current groundwater conditions on the site and in adjacent areas, including a description of site hydrogeology, groundwater flow, and groundwater-contaminant distributions. This report fulfills reporting requirements of the Resource Conservation and Recovery Act of 1976 (RCRA), specific Washington Administrative Codes, and the Atomic Energy Act of 1954 as implemented by U.S. Department of Energy (DOE) orders. This report also summarizes results of groundwater monitoring conducted to assess the effects of remediation or interim measures conducted in accordance with the Comprehensive Environmental Response,

Compensation, and Liability Act of 1980 (CERCLA). Staff within the Composite Analysis activity work closely with HGWP staff to evaluate the importance of new groundwater water-level and water quality data and information that have relevance to the Composite Analysis.

One of the key responsibilities of the Hanford Site Integration Program, which has recently been initiated, is to coordinate data gathering and characterization activities at Hanford. The Characterization of Systems activity within the Integration Program was set up to specifically integrate these activities across all major Hanford programs (DOE/RL 1999a). In addition, the Integration Program's Science and Technology activities related to flow and contaminant transport in the vadose zone and groundwater gathers data of interest to the Composite Analysis activity (DOE/RL 1999b). The Composite Analysis activity will maintain close contact with these Integration Program activities and make use of newly developed information in future revisions of the Composite Analysis.

2.0 Composite Analysis Reviews and Revisions

Requirements for composite analysis maintenance under DOE M 435.1-1 are the same as those for performance assessment maintenance and are described in Chapter 3 of DOE (1999d). This chapter describes the composite analysis review and revision process that should be conducted by DOE Field Element Managers to meet these requirements.

As required by DOE M 435.1-1, composite analysis maintenance includes the routine review and revision of the composite analysis. Reviews provide a mechanism for routine assessment of the site plans (e.g., remediation, closure, decommissioning, land-use) developed from the results of the composite analysis. This review process allows potential problems to be identified and managed at an early stage. The revisions ensure that there is cohesive documentation providing a reasonable basis to conclude that DOE requirements for radiological protection of the public and the environment will be met in the future. The composite analysis is a planning tool that allows Field Element Managers to evaluate the cumulative effects of all sources of radioactive materials that may interact with those in the low-level waste disposal facility. The impact of future activities on the dose to hypothetical future members of the public can be evaluated using the composite analysis, and the results used to develop land-use plans, remediation plans, long-term stewardship documents, etc. The annual review of the composite analysis is used to determine whether actual and planned conditions are consistent with those contained in the composite analysis. Revisions and special analyses provide a mechanism for evaluating conditions not originally included in the composite analysis to determine if they can be accommodated without violating the conclusions of the composite analysis.

The following sections address annual reviews to be conducted by the Field Element Manager, the annual summary to be submitted to Headquarters, revision of the composite analysis, and special analyses. The process of conducting annual reviews, advising Headquarters through annual summaries, and revising the composite analysis continues as necessary throughout the operational life of the disposal facility and during the institutional control period following closure.

2.1 Annual Determinations and Summaries

In accordance with DOE M 435.1-l requirements, the Field Element Manager is responsible for making an annual determination of the continued adequacy of the composite analysis. The annual determination is to be documented and retrievable.

The annual determination provides the mechanism by which the Field Element Manager evaluates whether current and planned site activities are consistent with the composite analysis and therefore, whether the conclusions of the composite analysis remain valid. This allows potential problems to be identified and managed before they affect site operations. Therefore, the review conducted to support the annual determination must be both retrospective and prospective. The Field Element Manager should review changes to actual or planned activities that have occurred over the last year with respect to the continued adequacy of the composite analysis in representing radiation dose to hypothetical future

members of the public. The review should also consider new information that has become available and the significance of this new information with respect to the conclusions of the composite analysis. In some cases, a special analysis may be necessary to determine the significance of changes or new information. Conduct of special analyses is described in Section 2.3.

The *R&D Implementation Plan* (DOE 1999i) requires the Field Office Low-Level Waste Program Office to make and document an annual determination of research and development needs related to low-level waste disposal. This process should be coordinated with the annual determinations required for each composite analysis as part of the maintenance process. The annual determination for each composite analysis should identify research and development needs that have been met during the past year, new needs that have arisen as a result of changes in actual or expected future conditions, and revised research and development priorities.

The result of the review should be documented in a memorandum that indicates the determination was made, the basis for the determination, and any specific actions to be taken as a result of the review. As described below, the review should include consideration of sources of residual radioactive material, land-use, results of monitoring and research and development activities, and other relevant factors. Specific discussion of these topics are provided in Sections 3.0 through 7.0 of this plan.

Appendix B of this plan contains the format and contents of this annual review extracted from DOE (1999d). As required by the *Disposal Authorization Statement for the Department of Energy Hanford Site Low-Level Radioactive Waste Disposal Facilities* (DOE 1999g), this determination shall be provided to the Low-Level Waste Disposal Facility Federal Review Group (LFRG) in an annual summary as described in Appendix B.

2.1.1 Status

A year has not elapsed since the 1998 Composite Analysis was conditionally approved (DOE 1999f); RL has not made the required annual determination for the composite analysis.

2.1.2 Plans

The overall schedule and deliverables anticipated between FY 2000 and FY 2003 is provided in Figure 2. An annual determination will be prepared per this maintenance plan beginning in FY 2001. Activities associated with the next revision of the Composite Analysis will be initiated in FY 2003 and completed by September 2004 to meet the requirement that the Composite Analysis be redone every 5 years. Because of the planned revision in FY 2004, no annual determination will be made during that year.

The overall schedule and deliverables anticipated between FY 2000 and FY 2004 is provided in Figure 2.1.

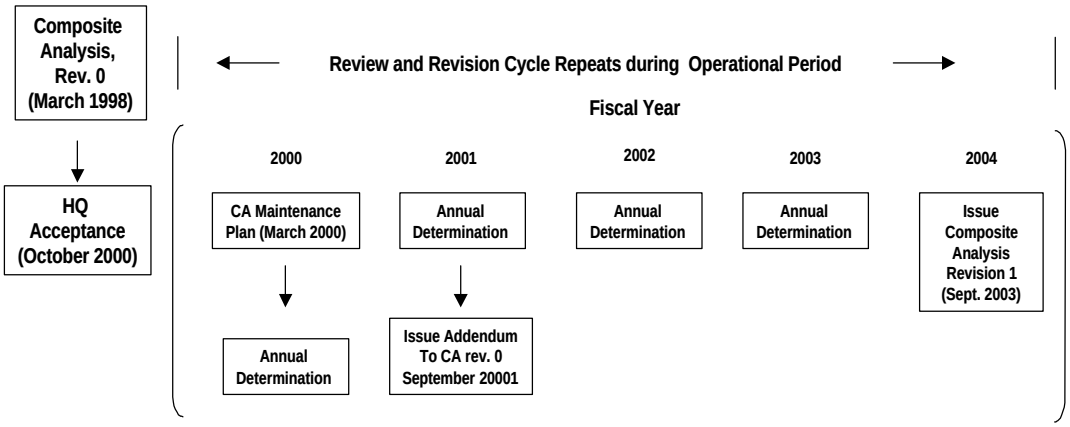

Figure 2.1. Overall Schedule and Deliverables for Composite Analysis Maintenance Anticipated Between FY 2000 and FY 2004

2.2 Composite Analysis Revisions

DOE M 435.1-1 IV.P.(3)(a) requires revision of the Composite Analysis when changes in waste forms or containers, radionuclide inventories, facility design and operations, closure concepts, or improved understanding of the performance of the waste disposal facility in combination with the features of the site on which it is located alter the conclusions or the conceptual model(s) of the existing Composite Analysis. The annual determination is designed to identify conditions that would necessitate revision of the Composite Analysis. The annual summary will identify specific conditions expected to result in changes to the conclusions or conceptual model(s).

A Composite Analysis revision is to include updated information (e.g., land use plans, results from monitoring and research and development), revised analyses, new models, changes in expected radionuclide inventories or other items affecting calculation of results. Consistent with the use of a graded approach, the form of the Composite Analysis revision can range from a simple amendment to the Composite Analysis to a re-issuance of the Composite Analysis document. If an amendment to the Composite Analysis is used, there must be a clear interpretation of how the information in the amendment relates to the original Composite Analysis and what it means relative to the conclusions reached in the Composite Analysis. In addition to submitting the Composite Analysis revision to the Deputy Assistant Secretary for Waste Management (or the Deputy Assistant Secretary for Environmental Restoration for low-level waste disposal facilities that are CERCLA sites), the Field Element Manager is also responsible for ensuring the revision is distributed to other parties, as appropriate. Other appropriate parties include interested stakeholders, and selected Field Office and Headquarters staff.

In determining how best to revise the Composite Analysis, the Field Element Manager should consider how cohesive and readily understood the Composite Analysis is or will be following the revision. For example, the revision may involve redoing transport and dose assessment calculations based on new

land use data (i.e., a new point of assessment). There would be no change to the conceptual models. In this case, it would be appropriate to prepare an amendment that presents the new data, the results of the revised analysis, and comparison of the new results to the dose limits and constraints. In another case, however, there could be substantial changes to site or facility characteristics that result in significant changes to the conceptual models. In this case, it would probably be appropriate to revise and reissue the entire Composite Analysis document. If a full revision of the Composite Analysis document is made, the annual determination is not necessary for the year the revision is made.

2.2.1 Status

Since the 1998 Composite Analysis (Kincaid et al. 1998) was only recently conditionally approved (DOE 1999f), the Composite Analysis has not yet been revised. As a condition of the acceptance (DOE 1999f, 1999g), an addendum of the Composite Analysis, Rev. 0 that will address a bounding sensitivity analysis of sources that was not considered in the Composite Analysis issued in 1998 will be prepared in FY 2001.

2.2.2 Plans

In FY 2000 and FY 2001, the Composite Analysis activity is currently focusing on inventory-related activities within the Integration Program to develop the necessary information to meet the first condition of acceptance of the Composite Analysis for a bounding sensitivity analysis of sources that was not considered in the Composite Analysis issued in 1998. Significant new information is under development within inventory related studies of the SAC and Science and Technology elements of the Integration Project. This information will be used in calculations associated with the addendum to the Composite Analysis, Rev. 0 that will be issued in September of 2001. The basis for these plans and schedule is provided in Appendix C (memorandum from D. Hildebrand to J. E. Rhoderick and W. E. Murphie, dated October 13, 1999.

Activities associated with the next revision of the Composite Analysis will be initiated in FY 2003 and completed by September 2004 (Figure 2.1) to meet the requirement that the Composite Analysis be redone every 5 years. In FY 2003, the responsibility for performing the Composite Analysis, Rev. 1 and future interactions of the Composite Analysis will be transferred from the Groundwater Modeling Task of the Hanford Groundwater Project, where it currently resides, to the System Assessment Capability element of the Integration Program.

2.3 Special Analyses

Special analyses are expected to be needed as part of the routine maintenance of the Composite Analysis. As used here, special analyses are analyses performed to evaluate the significance of new information to the results of the Composite Analysis, or to supplement or amend the analyses performed in the original Composite Analysis. A special analysis is not the same as revision to the Composite Analysis, but the results of the special analysis may be used to determine whether a Composite Analysis revision is needed. As described below, a number of different factors may prompt a special analysis.

As part of the annual review, the Field Element Manager may identify a concern or potential problem that should be evaluated. Resolution of the concern may require the acquisition of data through monitoring or research and development, or the use of existing data in a special analysis. Additionally, the Composite Analysis preparer may determine the need for special analyses due to errors found in the prior analyses. New information that is likely to change the results of the Composite Analysis, such as potential new sources of residual radioactive material or potential changes in land-use plans will generally require special analyses to quantify the changes in results. Also, ongoing research and development may yield results that warrant quantitative evaluation to determine their significance to the conclusions of the Composite Analysis.

From the perspective of site-wide planning, special analyses may be necessary to evaluate whether certain actions or changes can be made. This guidance cannot anticipate all of the changes that a site might consider, but the following indicate the types of changes that could necessitate a special analysis:

- changes in disposition of a potential source (e.g., *in-situ* rather than *ex-situ* remediation of a CERCLA site)
- additions of sources not analyzed in the Composite Analysis
- deletion of sources analyzed in the Composite Analysis (e.g., as a result of programmatic changes)
- changes in land-use plans.

2.3.1 Status

No other special analyses other than those involved in normal Composite Analysis maintenance analyses have been performed or are planned other than the bounding sensitivity analysis planned in FY 2001 (See Appendix C).

2.3.2 Plans

An addendum to the Composite Analysis, Rev. 0 is being planned for FY 2001 to perform a bounding sensitivity analysis of sources not considered in the first iteration using revised estimates of waste inventory being developed for the Systems Assessment Capability element of the Integration Program. No other special analyses have been performed or are planned. A special analysis will occur if new data are obtained that are not bounded by the previous Composite Analysis.

3.0 Sources of Residual Radioactive Material

An important aspect that will need to be considered in the annual determination of the adequacy of the Composite Analysis is new information on the sources of residual radioactive materials. The sources of residual radioactive material considered in the Composite Analysis form a key element of the basis for estimating dose to hypothetical future members of the public. The review of sources of residual radioactive material is to be based on a review of site documentation such as CERCLA records of decision (RODs), other CERCLA documents, RCRA documentation, plans for facility closure or decommissioning, plans for new facilities, long-term stewardship documents, etc. The review should consider the following:

- Is each source considered in the Composite Analysis still valid (i.e., have potential sources been eliminated due to changes in site plans)?
- Has new information become available concerning the radiological, chemical, and/or physical characteristics of the source?
- Have new sources been identified?
- Have new sources been characterized?

The review should be designed to determine whether the sources of residual radioactive material considered in the Composite Analysis are representative of expected future conditions.

3.1 Status

The following section provides a summary of key technical issues related to residual sources of radioactive materials that were identified in the Composite Analysis, Rev. 0 (Kincaid et al. 1998). These issues will need to be evaluated as part of the Composite Analysis maintenance program.

Inventory information was gathered by several independent programs and was used to assemble the inventory for the first iteration of the Composite Analysis. An examination of the total inventory assembled for the key radionuclides revealed a combination of issues that cannot be easily or quickly remedied, including 1) conservative estimates by individual programs, 2) conservative estimates of individual radionuclides, 3) no final identified disposal, 4) absence of key mobile radionuclides, and 5) use all available Hanford Site surveillance data and process knowledge. Each of these issues is briefly discussed in this section.

The Composite Analysis is the only analysis conducted in recent years requiring an inventory compilation that applies to all the radioactive wastes that will reside at the Hanford Site after closure. The method of assembling inventory data from independent sources has proven difficult to implement. When basic records focus on major radionuclides such as cesium-137, strontium-90, and isotopes of uranium

and plutonium, methods of estimating the abundance of the key mobile radionuclides became central to the inventory uncertainty issue. The second iteration of the Composite Analysis would benefit greatly from the creation of an inventory that honors, or reconciles, radionuclide generation data, import data, export data, process flow sheets, and waste transaction records. The inventory should be in a form, perhaps as a model, that permits the generation of uncertainty estimates or equally likely realizations.

3.1.1 Conservative Estimates by Individual Programs

A conservative approach to environmental analyses is incorporated into PA and risk assessment guidance and has gained acceptance. Whenever compliance to an environmental standard can be shown using a conservative analysis, there is little reason for a more accurate analysis. When a waste form can be shown to safely dispose of the entire Hanford Site-generated inventory of a radionuclide, there may be no reason for the program or project developing the waste form performance information to invest resources to better understand the true inventory. Using this logic, the TWRS program standard inventory used by Kincaid et al. (1998) has assigned all carbon-14, selenium-79, and iodine-129 generated in the reactors at the Hanford Site to reside in the single- and double-shell tanks. This effectively overestimates the amount of these radionuclides assigned to the tanks today, and therefore, to the future ILAW. Similarly, the inventory estimate for the ERDF trench was based on maximum observed contamination levels in remediation site wastes applied to the total volume of wastes to be disposed. This must result in an overestimated inventory; however, the Composite Analysis indicated leachate from this facility would not reach groundwater in the 1000-year period following Hanford Site closure. Consequently, estimated environmental performance alone will not require the development of a realistic or best-basis inventory for the ERDF trench.

3.1.2 Conservative Estimates of Individual Radionuclides

The quantity of selenium-79 was based on the Oak Ridge Isotope Generation and Depletion Code (ORIGEN2) simulations of the fuel irradiated in the production reactors at the Hanford Site. Among other data, those simulations relied on the decay half-life of the isotope. The half-life of this isotope was recently revised from $<6.5 \times 10^4$ years to $<6.5 \times 10^5$ years. As a result, the amount of selenium-79 generated in the fuel and introduced to the chemical separation plants will decline by a factor of up to eight. Because selenium-79 is overestimated in the current inventory, results indicating safe disposal at current inventory levels are conservative. When the total inventory of selenium-79 is revised, waste forms that now account for selenium-79 will show a decline in inventory and associated dose impacts.

3.1.3 Final Disposition of Some Waste Sites

In some cases, the final disposition of the radionuclide inventory in waste and contained in closed facilities is not well defined. In the Composite Analysis, estimates of the inventory and its location were needed. Thus, when using the calculated total inventory generated in the reactors, it must be determined where that inventory will reside at the time of Hanford Site closure. Because that time is sufficiently far away, several DOE programs have not developed an understanding of their inventories and where they will finally reside. Iodine-129 is a good example. The amount of iodine-129 lost to the atmosphere and trapped in scrubbers and disposed elsewhere (e.g., solid waste burial grounds or Plutonium-Uranium

Extraction [PUREX] Plant tunnels) is highly uncertain, and therefore, not quantified in the standard or best-basis inventory developed by the past TWRS program. Consequently, to be conservative and bound the iodine-129 issue with regard to tank waste, all iodine-129 was assigned to the tanks. Of that total, 10% was assigned to the ILAW to bound the potential dose impact of this radionuclide on ILAW performance. However, this is a conservatively high estimate of the amount of this highly volatile isotope that will be trapped in vitrified waste. The ultimate disposition of the iodine presumed in the tanks, (i.e., 66 Ci), is not well defined.

In nearly all analyses of closed facilities conducted to date (e.g., hazard assessments, waste volume estimates), the inventory data included only major radionuclides (e.g., cesium-137, strontium-90, uranium, and plutonium) or an inventory of the total fission products and total activation products. Neither of these types of inventory provides sufficient information to perform all-pathways exposure and dose analyses. This has made the simulation of some facilities and waste sites intractable for the first iteration of the Composite Analysis.

3.1.4 Absence of Key Mobile Radionuclides

In general, the radionuclides that have been identified as key to the estimation of maximum all-pathways dose have long decay half-lives and are relatively mobile in the subsurface environment. They are carbon-14, chlorine-36, selenium-79, technetium-99, iodine-129, and uranium (total). Chlorine-36 is included because of its known presence in the graphite reactor cores. Its potential impact in other waste has also been studied by incorporating a hypothetical amount in irradiated fuel, and therefore, in the Hanford Site waste streams. Three of the radionuclides, carbon-14, iodine-129, and uranium (total), exhibit a small degree of sorption in the environment. With the exception of uranium, the mobile and long-lived radionuclides were not routinely measured and reported during the production period at the Hanford Site.

While it is common to find cesium-137, strontium-90, uranium (isotopic or total), and plutonium (isotopic or total) reported in inventory records for specific facilities, the other radionuclides are not commonly found. The abundance of the mobile and long-lived radionuclides in irradiated fuel is estimated in the total standard inventory. However, records are incomplete with respect to their quantities discharged to the environment as gaseous atmospheric releases, to liquid discharge sites (e.g., cribs, specific retention trenches, reverse or discharge wells), or to solid waste burial grounds. Improved confidence in the quantities of the mobile radionuclides assigned to liquid discharges, tank leaks, and solid waste requires an accepted means of estimating with confidence the abundance of carbon-14, selenium-79, technetium-99, iodine-129, and perhaps chlorine-36 for gaseous, liquid, and solid waste disposals.

3.1.5 Use of All Available Data and Process Knowledge

It is fundamentally important to use process knowledge and transfer records to estimate the timing, volume, and inventory of wastes discharged or lost to the environment. The combined 216-U-1&2 crib site, described by Kincaid et al. (1998) is an example where a combination of process knowledge and field observations could yield an improved estimate of the original release to a liquid discharge site. A

series of events culminated in the detection of a release of uranium in solution to the water table in the vicinity of this crib site in February 1985. The observed uranium plume in the groundwater was, and is, significant. Periodically, it has been the subject of pump-and-treat programs since its discovery. A significant technetium plume appeared at the same time and occupies the same groundwater. Its source is assumed to be the same crib site. However, technetium-99 disposed to the 216-U-1&2 cribs has not been estimated, based on either the likelihood that technetium-99 followed uranium in the U Plant process that generated the waste stream, or the knowledge that a substantial quantity of technetium-99 is now in the aquifer beneath these cribs. Because the Composite Analysis was based on the assembled inventory, the analysis of liquid discharges does not predict the present technetium-99 plume beneath the 216-U-1&2 cribs. This plume was modeled as an existing plume, and results show that before its migration from the buffer zone, it will disperse and its dose consequences will greatly diminish. Existing databases that reveal the temporal and spatial extent of contamination in the environment are a valuable asset in the assessment of the original discharges. While these data may be incomplete, they do provide valuable clues to the presence of specific radionuclides and their relative abundance.

3.1.6 Case for a Single Inventory Estimate

The absence of an inventory generated with a view toward a best estimate of the final location and inventory of all wastes makes it virtually impossible to perform a meaningful study of sensitivity because too many possible realizations could be generated, and improbable realizations would be admitted. In the study of an isolated facility or waste form, (e.g., as in a PA), the influence of various levels of inventory can be examined. However, an assessment of uncertainty in inventory for the Composite Analysis requires alternate inventories for both location and quantity. It is the potential cumulative impact of multiple disposals at a moment in time and point in space that creates the maximum composite dose. Thus, the uncertainty in composite dose is a function of uncertainties in inventory, release, migration, and exposure. The total or global estimate of inventory, based on reactor operation, is the best information on inventory at the Hanford Site. Upper bound estimates of inventory disposed at most facilities are unknown and unknowable. Thus, inventories assigned to each facility or type of facility must be associated with the known range of inventory for each. In other words, the inventory realizations generated must be equally probable for the assessment of uncertainty to be meaningful. For example, if less of a specific isotope is in the tanks today (and will eventually be in ILAW and immobilized high-level waste), more of that isotope should be assigned to one or more of the following inventories:

- lost in gaseous form to the atmosphere during chemical separation processes
- disposed in liquid form to the subsurface
- disposed in solid form to burial grounds
- residing in canyon building vessels or structures or filters
- residing in PUREX tunnels in process vessels.

The perturbations possible in the assignment of inventories to specific waste disposal facilities must be constrained by our knowledge of processes and field observations. Before useful sensitivity cases capturing our uncertainty in the inventory can be formulated, the internal dependencies or correlation of the inventory problem must be incorporated into a collective best-estimate model. Only then can the true significance of real uncertainties be determined through simulation of environmental consequences.

Bounding estimates of inventory may be meaningful in the Composite Analysis when examining a single facility or class of facilities. However, with few exceptions, reaching consensus on a bounding inventory for a specific facility or waste form could be difficult. Such estimates may be useful when attempting to determine the maximum potential influence of a facility outside the buffer zone. Similarly, one may wish to determine the inventory required in a facility to cause a given impact outside the buffer zone. Such analyses would be useful in evaluating the need to retain a given facility or class of facilities in the Composite Analysis. Certainly, as in any environmental assessment, if the release processes or migration pathway constrain the dose impact to levels well below the performance standard, then bounding inventories could be assigned to all sources to simply illustrate the ultimate safety of the waste form or physical setting. However, such simulations do not quantify the influence of an uncertain inventory. They provide a reasonable assurance of no impact from any reasonable inventory.

3.1.7 Inventory Uncertainty with Respect to Dry Disposals

Given the assumptions regarding future land use, the results obtained in the first iteration of the Composite Analysis illustrate that inventories assigned to the active and planned disposals will not yield significant releases in the 1000-year period following Hanford Site closure. The analysis also indicated that increased inventories assigned to these disposals would not yield significant releases in the 1000 years. To ensure that no significant releases from the burial grounds are possible, waste acceptance criteria and procedures (WHC 1993) were applied to screen each waste package for mobile radionuclide content (e.g., carbon-14, selenium-79, technetium-99, iodine-129, and uranium) before disposal and to determine if mobile radionuclide inventories are sufficiently high to require additional isolation from the environment. Typical immobilization processes are encapsulation of waste packages in thick concrete boxes or direct grouting of the waste material. This protocol ensures that no one package can provide a substantial portion of allowable dose. Neither the ERDF nor the ILAW disposal facilities are predicted to release any radionuclides in the 1000-year regulatory period.

Thus, the inventories analyzed yield maximum dose well below the DOE dose limit and constraint levels. Additional inventories, if identified for future disposals in the burial grounds, would be immobilized before disposal and would be determined to be safe for long-term disposal before acceptance. Therefore, further analysis of the radioactive waste inventory with respect to incremental dose impacts from solid waste burial grounds, the ERDF, and the TWRS ILAW would not yield additional insight and are not included in the Composite Analysis.

Much has been accomplished in the past two decades to document the inventories of radionuclides and chemicals present at the Hanford Site. Process knowledge and waste transfers have been documented. The Track Radioactive Components (TRAC) model was developed (Jungfleisch 1980, 1983) and has been superseded by the Hanford Defined Waste (HDW) model (Agnew et al. 1997). The HDW

model uses all available information; however, its development has been driven by the need to estimate the contents of single- and double-shell tanks. As mentioned above, some inventory entries are conservative estimates.

While appropriate for individual programs, conservative or bounding estimates are not as useful for the Composite Analysis. For the Composite Analysis, a conservative assessment implies a sequence of events that cause multiple plumes to arrive simultaneously at a point in space and moment in time. PAs differ from the Composite Analysis because the former examine contaminants from a single source passing a single point in space. By using a conservative inventory estimate, one maximizes the dose consequence. This is not true of the Composite Analysis unless conservative estimates of inventory are used for all sources.

The inventory for the Hanford Site should be viewed, in a holistic sense, as a conserved quantity. Ideally, each nuclide has a known inventory for the Hanford Site based on the quantity imported or generated in the reactors. For those sites with potentially significant releases to the water table, it is important to examine the tradeoffs of inventory uncertainty. A greater inventory assigned to liquid discharge sites should correspond to a smaller inventory assigned to existing tank waste and future ILAW disposal. An estimate of the inventory emitted to the atmosphere should be accounted for in the overall inventory. That portion recovered by scrubbers and disposed at the Hanford Site should also be traced through the inventory to its final disposition. Ultimately, the most meaningful uncertainty analysis of inventory would be based on a best-estimate rather than bounding estimate.

Finally, if a full options analysis and ALARA assessment must be completed to evaluate alternate remediations, the Composite Analysis is used to identify those disposals most responsible for the dose. Alternate remediations must be proposed and studied for wastes that have the greatest impact rather than others of less significance. If bounding inventories have been used in the Composite Analysis, the analysis may need to be redone before proceeding with the options analysis and ALARA assessment.

Thus, the site-wide inventory assembled for the second iteration Composite Analysis should be a balanced and best estimate. The estimate should be balanced in the sense that gaseous, liquid, and solid waste inventories are accounted for, consistent, and linked. This would enable sensitivity cases to be generated that examine the implications of a greater inventory lost to the atmosphere or sent in the liquid waste streams to cribs or tanks. The estimate needs to be centered about a best estimate that places waste where it is most likely to reside at the conclusion of Hanford Site operations. Sensitivity to inventory estimates could be analyzed as independent realizations that would be created by routing more or less waste to the atmosphere, to the liquid discharges sites, to the single- and double-shell tanks, and to the solid waste burial grounds. Reviewed and accepted methods of estimating the key mobile radionuclides of greatest importance to long-term health and safety studies should be incorporated into the inventory model.

Such an inventory should be based on the HDW (Agnew et al. 1997) or a similar model of the Hanford Site inventory and the standard or best-basis inventory of Kupfer et al. (1997). It would then be possible to examine perturbations in the inventories assigned to specific waste disposal facilities. The assignments would be conditioned on the knowledge of processes and constrained by the knowledge of

waste transfers. The influence of assumptions could be traced through the inventory estimates. For example, the assumed split of iodine-129 between gaseous and liquid phase, and the assumed effectiveness of silver-nitrate saddles in removing the iodine from the gaseous phase, could be traced through to their resulting inventories assigned to the atmosphere, the solid waste landfills, and the liquids stored in tanks. Such a model would remedy the present issue of full accountability for the final disposal of key radionuclides including carbon-14 and iodine-129.

3.1.8 Inclusion of Additional Sources

Numerous liquid discharge sites and canyon facilities were not modeled in this iteration of the Composite Analysis. In the case of liquid discharge sites, this is justified only by the belief that the most significant releases have been estimated and therefore are included in current inventories. However, because inventory estimates are created for liquid-release and leak sites and canyon facilities are not included in the first iteration, they will be included in future iterations of the Composite Analysis. The canyon buildings, their immovable underground filter assemblies, and the PUREX tunnels are another group of sources that need to be included in future analyses. The potential impacts of cesium-137 and strontium-90 in the B Plant and in its sand and HEPA filters were included as a preliminary analysis of these major radionuclides. However, the inventory and location of the key mobile radionuclides in these structures need to be developed as the basis of a credible analysis of their potential impact.

A major issue related to this technical area was articulated in the final report of the Low-Level Waste Disposal Facility Review Group for the Composite Analysis dated July 26, 1999. In this report, the review team recognized that these additional sources are potentially significant sources that should be analyzed as soon as possible. The PUREX tunnels, chemical separation plants, and CERCLA sites were excluded based on lack of inventory data for these source terms. However, based on discussions the review team had with site personnel during their site visits and knowledge of site operations, the team believed there is sufficient information to provide bounding estimates of releases from these sources. The review team noted that excluding these sources weakens the current analysis and recommended that additional effort should be dedicated in the near future toward developing estimates for these sources and conducting sensitivity analyses to determine if they significantly affect the results of the analysis.

The review team also noted that secondary streams from tank remediation were also not evaluated in the analysis primarily due to uncertainty regarding the content and magnitude of these waste streams. In the current analysis, the technetium-99 inventory was assumed to be contained in the glass waste form in the Immobilized Low-Activity Tank Waste (ILAW) disposal facility. However, during the review team's site visit, they received information that the technetium-99 may be separated from waste streams leading to the ILAW glass and disposed in the 200 Area as another waste type. This approach may lead to another significant source term that behaves differently from that specified in the ILAW waste form. The review team recommended that changes in plans for handling secondary wastes streams should be monitored and included in future revisions of the Composite Analysis.

3.2 Plans

In the broad area of waste characterization and inventory, the Composite Analysis activity will rely on new information and data that is anticipated from a number of ongoing programs to resolve the variety of waste inventory issues identified in the first iteration of the Composite Analysis. The key relevant site activities will include

- Inventory-related task within the Integration Program that will provide holistic inventory estimates for use in the initial assessment based on the System Assessment Capability (SAC)

- New information on disposed wastes and revised projected waste inventories from:
  - 200 East and West Solid Waste Burial Grounds operations
  - ERDF operations

- Potential revised projected tank waste inventories that will be:
  - lost during sluicing during the tank retrieval process
  - left in place as residuals in single-shell and double shell tanks
  - disposed at the ILAW disposal facility
  - disposed as a separate waste form or secondary waste stream originating from the tank waste vitrification plant.

Initial estimates will be developed in FY 2000 for use in the calculations performed in the SAC activity in FY 2001. These estimates will also assist the Composite Analysis activity in development of inventories needed for the bounding sensitivity analysis that will be performed in FY 2001 (See Appendix C). These estimates will continue to be refined with input from site waste management, environmental restoration, and tank closure programs, and inventory estimates being developed by the science and technology elements of the Integration Program over the next several years for use in subsequent versions of the Composite Analysis.

4.0 Land Use

Future land use is another key element of the basis for estimating dose to hypothetical future members of the public and changes in land use must be considered in annual determinations of the Composite Analysis (DOE 1999d). The review of land use is to be based on a review of documentation such as land-use plans or planning documents, National Environmental Policy Act (NEPA) documents (e.g., environmental assessments, environmental impact statements), long-term stewardship documents, surveys of land use (past, present, and projected) adjacent to the DOE site, and other relevant documents. The review should focus on determining whether the future land use identified in the composite analysis is representative of the most current land-use plans for the site. The overall result of the review will be a determination of whether any changes are needed to ensure the continued adequacy of the composite analysis with respect to land use assumptions.

4.1 Status

According to the LFRG review team final report of the 200 Area plateau Composite Analysis, results of the analysis are conditioned on the assumption that the buffer zone for the 200 Area exclusive waste management zone will be extended to surround the Gable Mountain Pond area and an area of groundwater currently contaminated with strontium-90. For conclusions of the Composite Analysis to be valid, the Gable Mountain Pond area must be formally included into the land use planning surrounding the 200 Area exclusion zone. Alternatively, the Hanford Site could commit to remediating the Gable Mountain Pond area and related strontium-90 plume. This issue, while not necessarily a specific technical issue for the Composite Analysis maintenance plan, highlights the need for the Hanford Site to finalize land use planning surrounding the 200 Area exclusion zone and fully integrate it with work being conducted within land use planning activities.

The most recent work on land use planning at Hanford is embodied in the Hanford Site Land Use EIS (DOE 1999h), which outlines land uses for the site over the next 50 years. The issue of Gable Mountain Pond was not specifically addressed in the final record of decision developed from this EIS issued at the end of 1999 (DOE 1999j) but RL is aware of the issue raised by the Composite Analysis. RL will consider this finding and ongoing characterization work being conducted at Gable Mountain Pond by the 200 Area Characterization Program in its final land-use planning following site closure.

4.2 Plans

The Composite Analysis activity will be monitoring developments related to land use planning decisions resulting from the Hanford Site Land Use EIS and related to the contaminated area beneath Gable Mountain Pond. Changes in land use planning will be incorporated in the next revision of the Composite Analysis.

5.0 Monitoring, Research, and Development

The review of monitoring and research and development results consists of several activities, including:

- evaluating monitoring results for consistency with Composite Analysis and conceptual model(s)
- evaluating research and development results to determine impacts on Composite Analysis results and conclusions
- determining if better methodologies or technologies are available
- evaluating the results of special studies.

The review should be designed to determine if data collected during monitoring or research and development activities indicate that the conceptual model(s) and data used for the Composite Analysis are still applicable. Additionally, the review should provide information needed by the Field Element Manager to update the status of research and development needs related to low-level waste disposal safety.

A variety of monitoring efforts may be applicable to the sources considered in the Composite Analysis. Monitoring is required for the low-level waste disposal facility, and the results of the Composite Analysis must be considered in developing the monitoring plan (DOE 1999d). Sources of radioactive material that are CERCLA or RCRA sites should have monitoring programs based on applicable requirements under CERCLA or RCRA. Monitoring of other sources, as well as site-wide environmental monitoring, may be required under DOE Order 5400.1, *General Environmental Protection Program*.

Data collected as part of the above monitoring programs should be reviewed to determine whether they are consistent with the conceptual model(s) and data used for the Composite Analysis. For example, if the Composite Analysis includes a source that is a CERCLA site that will undergo future *in-situ* remediation, the Composite Analysis may be based on the assumed performance of the remediation. Monitoring data collected after completion of the remedial action would then be used to determine the validity of the assumptions used in the Composite Analysis. Similarly, the Composite Analysis may be based on assumed future values of residual radioactivity that will remain after facilities are decommissioned. Monitoring performed after decommissioning is completed would be used to determine actual values of residual radioactivity. When monitoring data are compared to data used in the Composite Analysis, the significance of the monitoring data to the results of the Composite Analysis should be assessed. Specifically, the reviewer should evaluate whether the monitoring data indicate that the results of the Composite Analysis are more or less conservative than expected. In some cases, a special analysis may be needed to assess the significance of the data (DOE 1999d). Monitoring results from the low-level waste disposal site monitoring program will be discussed in the annual summary for the performance assessment. For Composite Analysis maintenance, these data should only be reviewed to determine if they have implications with respect to sources other than the low-level waste disposal facility.

The review of research and development results should include those available from on-site studies, as well as those from studies conducted at other sites. The former should be identified in the Site-Wide Radioactive Waste Management Program required by DOE M 435.1-1, while the latter should be identified in the database to be developed and maintained by the Low-Level and Mixed Low-Level Center of Excellance (the Center) (DOE 1999d). This database should be reviewed to identify potential sources of research and development results applicable to data needs associated with the Composite Analysis. These database reviews are to be documented annually by the Field Office Low-Level Waste Program Office.

Once applicable research and development results have been identified using the above sources, they should be reviewed with respect to the data and conceptual model(s) used in the Composite Analysis. The review should specifically address data gaps and uncertainties identified during preparation and review of the Composite Analysis. Research and development results that address these data gaps and uncertainties should be evaluated with respect to their impact on the results and conclusions of the Composite Analysis. This evaluation should address whether the results of the Composite Analysis are more or less conservative then expected and whether the conclusions of the Composite Analysis are still valid. In some cases, a special analysis may be required to make these evaluations (DOE 1999d).

In some cases, instead of data, research and development results will consist of improved analytical methods (e.g., computer codes). In these cases, the review should determine whether application of these improved methods to the Composite Analysis would reduce the uncertainty associated with the results of the analysis. If so, the significance of the reduced uncertainty should be discussed. In some cases, it may be appropriate to conduct a special analysis to quantitatively evaluate impact of the method on Composite Analysis results.

The review of research and development results should also assess the status of research and development with respect to previously identified data needs and uncertainties. As described in DOE (1999d), this information will be used to update the research and development planning and implementation process.

5.1 Status

The following is a discussion of key issues identified in the Composite Analysis, Rev. 0 (Kincaid et al. 1998) that have relevance to the areas of monitoring, research, and development.

Recent peer review of vadose zone contamination beneath single-shell waste tank 241-SX-109 was critical of Hanford Site knowledge of contaminant migration resulting from a tank leak (DOE/RL 1997). The panel found insufficient information to defend a single conceptual model of the physical path and chemical mobility of cesium-137 and other radionuclides leaked to the subsurface. Alternate conceptual models stress the potential roles of natural heterogeneity, man-made preferential flow paths, fluid density, and geochemical mobility on the migration and fate of contaminants. The Tank Waste Vadose Zone Program is underway to gather data to better define the present distribution and future mobility of contaminants in the vadose zone beneath tank leaks. In addition, DOE has created the Hanford Groundwater and Vadose Zone Integration Program to coordinate the study of the vadose zone across the various environmental management and environmental restoration programs at the Hanford Site. Developing

confidence in models of contaminant migration and fate for the vadose zone beneath liquid discharge sites and leaking tanks must await completion of the early stages of these programs. The Hanford Groundwater Program, which has responsibility for site-wide, Resource Conservation and Recovery Act (RCRA) site and CERCLA site monitoring has been investigating evidence that suggests impacts to groundwater from past leaks at a number of single-shell tank farms. These assessments are ongoing and will likely provide some evidence and information about the timing and magnitude of potential tank leak impacts to local-scale groundwater. The second and subsequent iterations of the Composite Analysis will benefit from these programs.

5.1.1 Geochemical Mobility

Unlike previous site-wide analyses, the Composite Analysis of wastes within the exclusive waste management area and buffer zone distinguishes among six waste types that were discharged or leaked to the subsurface environment. Based on the waste characteristics and an assumed amount of contact with subsurface sediments, the chemical elements were assigned distribution coefficients for each of the waste types and three geologic settings; an upper vadose zone, the lower vadose zone, and the unconfined aquifer (see Appendix E of the Composite Analysis [Kincaid et al. 1998]). Thus, in this analysis process waste streams with a high organic content and very acidic pH have been assigned a different mobility than wastes with a low organic content and a near-neutral pH.

Based on post-mortem studies of cribs, specific retention trenches, and tank leaks conducted during the late 1970s and early 1980s, the vadose zone was divided into two segments. The waste type governed the selection of the distribution coefficient in the upper segment. A combination of waste-type and sediment interactions governed the assigned value in the lower segment. In general, although not always, the wastes are more mobile in the upper segment and less mobile in the lower segment. This conceptual model applies to the liquid discharges to the sediment profile including tank leaks and losses from tanks during recovery operations.

Wastes in the dry disposal sites, including all solid waste burial grounds, the ERDF trench, and the TWRS ILAW disposal facility, were assumed to have a low-organic content, a low-salt content, and a near-neutral pH. Accordingly, chemical elements in these wastes were assigned a single distribution coefficient that applies throughout the sediment column. Best-estimate values of distribution coefficients for carbon, iodine, and uranium were 5, 0.5, and 3 mL/g, respectively. Chlorine, selenium, and technetium were all assigned 0 ml/g and were assumed to move with the water. Conservative values for carbon, iodine, and uranium are 0.5, 0.3, and 0.6 ml/g, respectively. None of the sorbed contaminants from dry disposal sites are predicted to reach the water table in the period analyzed. The more mobile chlorine, selenium, and technetium radionuclides behave identically in both cases. Interestingly, if carbon and uranium were simulated using their conservative values of distribution coefficients (0.5 and 0.6 ml/g, respectively), their behavior would be similar to that of iodine with its best-estimate value of distribution coefficient (0.5 ml/g). Neither would reach the aquifer in 1000 years. Thus, a sensitivity analysis of the geochemical mobility of wastes disposed in the solid waste burial grounds, the ERDF trench, and the TWRS ILAW disposal facility would not reveal significantly different results in the 1000-year regulatory period.

5.1.2 Hydrogeologic Mobility

There is a fundamental difference between liquid discharges (including tank leaks), and dry disposals. Liquid discharges carry the contaminants into the vadose zone beneath the liquid discharge facility. This liquid, including radioactive contamination, seeks to redistribute in the vadose zone such that it comes into equilibrium with the surrounding soil water. Continuous liquid discharges move liquid waste and associated contamination deep into the vadose zone, eventually resulting in breakthrough to the water table. Short-term and lower-quantity discharges displace the resident soil water and then are driven more slowly by natural recharge as they also migrate downward to the water table.

The hydrologic driver for dry disposals is the recharge rate. Solid waste burial grounds at the Hanford Site are typical. Once in place, they are covered by 2 m of backfill pending placement of a final surface barrier system. In the base case, a sequence of recharge rates indicating a site covered with coarse soil and maintained free of vegetation (75 mm/yr) followed by the site covered with a surface barrier (5 mm/yr) has been examined. One important nuance of this recharge and release scenario is that wastes were leached throughout both periods, i.e., it was assumed waste containers did not present a barrier to direct and immediate leaching by pore water during the period before surface barrier construction. In this scenario, pre-1988 solid waste burial grounds release waste to the water table in the first decades of the next century. Post-1988 disposals exhibited releases of the most mobile contaminants (chlorine-36, selenium-79, and technetium-99) in approximately 200 years, but no release of less mobile contaminants (carbon-14, iodine-129, and uranium) in 1000 years.

The comparison case for solid waste burial grounds examined the scenario where leaching of the waste did not begin until after the surface barrier with a recharge rate of 5 mm/yr was constructed over the trenches. Essentially, this case is based on the assumption that waste containers minimize or preclude direct leaching of the solid waste until the barrier is in place. This case duplicates an essential feature of the analyses presented in the PAs for the post-1988 solid waste burial grounds (Wood et al. 1995, 1996). Because of the integrity and durability of containers employed since 1984, the comparison case is believed to be a better representation of future burial ground performance. In this comparison case, post-1988 disposals exhibited mean travel times of approximately 1070 years from burial grounds in the 200 West Area, 1150 years from the 218-E-10 burial ground, and 650 years from the 218-E-12b burial ground. The majority of future solid waste is destined for 200 West Area burial grounds, and therefore, the mean travel times on the order of 1000 years will govern the majority of future releases.

The consequences of not constructing a surface barrier and applying a higher recharge rate (e.g., 50 mm/yr.) over the long-term were studied in the published PAs (Wood et al. 1995, 1996). They concluded that a surface barrier tailored to the site and waste conditions should be designed and constructed over the burial grounds.

It is unlikely that more rapid leaching of the solid waste could occur than is characterized in the base case. The comparison case performed for the Composite Analysis captures a more likely scenario; however, low-level waste containers are not specifically designed to defeat leaching by pore water for extended periods of time. When solid waste is dry and not corrosive, the container likely will survive and protect the waste from leaching phenomena. Further, moisture inside waste packages is largely

eliminated by waste acceptance criteria requiring free liquid to be sorbed inside the package (WHC 1993). The comparison case may be extreme in the sense of preventing any release until the low recharge rate influences both the release and its subsequent migration.

The model employed in the Composite Analysis to represent contaminant transport in the vadose zone is one-dimensional. One shortcoming of such a model is its inability to quantify the multidimensional aspects of the analysis. Placement of a surface barrier implies an immediate and complete change in the recharge rate that is leaching the source and driving contaminants through the vadose zone. Edge effects of a barrier are neglected. In general, the distance from the land surface to the water table beneath the exclusive waste management area is less than 100 m. The physical size of the four disposal facilities under consideration suggests their barriers will be more than 100 m across, and it is anticipated that the barrier will be extended well beyond the disposal facility. Consequently, the opportunity for edge effects, i.e., moisture moving under the barrier in the vicinity of its edge, to leach the disposed waste or accelerate its migration to the water table is less than might be envisioned. For example, only those wastes near the edge of the barrier could be exposed to greater leaching, and if the barrier is extended well beyond the edge of the disposal this is less likely to occur. Similarly, the ability of the edge-effect recharge to affect the transport pathway also will decrease with the length of extension. Thus, assuming that the future barrier design will include sufficient edge extension beyond buried waste deposits, the base case and sensitivity cases capture the range of likely environmental responses.

5.1.3 Uncertain Mobility with Respect to Dry Disposals

Although dry disposals in solid waste burial grounds, the ERDF trench, and the TWRS ILAW disposal facility are a primary focus of the Composite Analysis, this first iteration of the analysis has shown the importance of liquid releases (e.g., liquid discharges and tank leaks) and their migration and fate. Dry disposals are influenced by the recharge rates through disturbed surfaces and engineered surface barriers as compared to higher rates experienced at liquid release sites. Similarly, solid wastes are subject to more favorable geochemical mobility factors (i.e., distribution coefficients) than some liquid release sites. The cases reported in the Composite Analysis capture the range of conditions most likely to govern the mobility of these wastes and illustrate the safety of these dry disposals.

The review of the 241-SX-109-tank leak experience (DOE/RL 1997) has placed previously accepted vadose zone conceptual models in question. Ongoing field studies are underway with the purpose of developing better information on the physical extent and chemical mobility of tank wastes leaked to the subsurface. This knowledge will enhance our ability to quantify the environmental response of liquids discharged to specific retention trenches and lost from tanks during waste recovery operations.

Through field study of leaks from tanks and discharges to cribs, the pathways and mobility of contaminants will become better understood. Based on the field evidence and our knowledge of the waste, alternate conceptual models of waste migration and fate in the subsurface can be posed. Conceptual models capture the physical features and physicochemical processes that produced the observed situation. They can be further studied through numerical simulation, and the alternate explanations of events can be narrowed to the few or one that best explains all of the field observations.

Issues that require resolution include explanations for the initially high mobility of some wastes and an evaluation of their ability to create or follow preferential flow paths. Another issue involves the ability of barriers to prevent leaching of the waste and ensure a slow flow and transport path to the water table (i.e., quantification of the edge effect of a surface barrier). Of particular importance to the second iteration Composite Analysis will be the development of confidence in estimates of long-term leaching and migration of wastes from dry disposals. The behavior of these dry disposal sites is difficult to study in the field because of the low release rates of dry waste. Under a dry regime, the migration of the release is less likely to find and then follow geologic formations (e.g., interfaces between coarse- and fine-grained sediments) that may represent preferential flow paths under wetter or saturated conditions. The release and migration will require special attention because they occur in a much drier regime than at the liquid disposal sites. Because of the time they have been exposed to potentially greater infiltration rates, the pre-1988 solid waste burial grounds may provide an opportunity to measure release and migration from burial grounds under less-than-optimal conditions.

Our increasing knowledge of the physical position and chemical character of radionuclides in the vadose zone beneath tank leaks and liquid discharge facilities should be incorporated into the conceptual and mathematical models. By necessity, a one-dimensional model of the vadose zone was employed to simulate the numerous waste sites within the exclusive waste management area in the first iteration Composite Analysis. The greater understanding of contaminant migration in the vadose zone that will come from the ongoing and future vadose zone studies will either lead to the creation of more comprehensive, applicable, and accepted one-dimensional models or point to the need to perform multidimensional simulations of specific facilities or wastes. Certainly, the decision to proceed with the development and application of more sophisticated vadose zone transport models will be based on the perceived value of their predictive capability. An evaluation of their potential value may be approached through simulations with simpler models tailored to bound the potential impacts of the unresolved processes (e.g., multiphase physics, aqueous speciation, adsorption, precipitation) and geometries (e.g., two- or three-dimensional phenomena, preferential pathways) of a more sophisticated model. Studies may also conclude that probabilistic models are required. Regardless, completion of these studies and the implementation of the next generation models will lead to greater confidence in future iterations of the Composite Analysis.

In their final report dated July 26, 1999, the LFRG review team commented on the need for the Composite Analysis team to provide additional justification for the use of the current approach of changing Kd at specific depths to account for enhanced mobility of certain constituents. The review team also noted that future iterations of the Composite Analysis should also consider oxidation-reduction potential as a discriminating characteristic in the selection of Kds on the composite analysis.

Field observations must play a greater role in determining the base case conditions at the Hanford Site. Existing plumes in the vadose zone and groundwater are evidence of contaminant release and mobility. In response to CERCLA and RCRA guidance and DOE Orders 5400.1 and 5400.5, a groundwater protection management plan is routinely issued for the groundwater resources at the Hanford Site (Barnett et al. 1995). This plan describes the ongoing monitoring efforts. Before the next iteration of the Composite Analysis is completed, efforts should be made to include in this plan the work necessary to sample the aquifer for more of the key mobile radionuclides identified in the Composite Analysis

including selenium-79 and chlorine-36. Similarly, efforts should be made to determine the distribution of key mobile radionuclides in the vadose zone beneath cribs, specific retention trenches, reverse wells, and tank farms.

Special efforts should be undertaken to sample groundwater and characterize the vadose zone in the vicinity of liquid discharge facilities (cribs, specific retention trenches, and reverse wells) and tank leaks that received the largest quantities of waste having large inventories of key mobile radionuclides. Recently identified radionuclides such as selenium-79 and perhaps chlorine-36 should be added to laboratory analyses of water samples. In part, such efforts should attempt to substantiate the estimate of inventory (mass) and contaminant concentration discharged to the environment.

The sampling strategy should be designed to yield results suitable to provide an estimate of the mass of contaminant in the aquifer or vadose zone. Point samples taken at moments in time are prone to miss peak concentrations. Sampling a substantial interval of aquifer provides an integrated sample biased toward the water quality of the most conductive strata intercepted by the sample. Sampling short intervals over the depth of the vadose zone or aquifer borehole could provide valuable insight on contaminant distribution. Analysis of small intervals could identify sediment layers responsible for adsorption or precipitation phenomena in the vadose zone. Such an analysis of saturated sediments would begin to reveal the three-dimensional distribution of contaminants throughout the aquifer. Methods of estimating the contaminant mass, including a best estimate and range, are needed for comparison to model results of key mobile radionuclide discharges. Inventory estimates of key radionuclides discharged to cribs and leaked from tanks should be conditioned by our knowledge of the mass of those radionuclides found in the vadose zone and aquifer.

5.2 Plans

In the area of monitoring of mobility of key contaminant, the Composite Analysis activity intends to maintain an awareness of key results of ongoing characterization programs at the Hanford site including:

- The Tank Waste Vadose Zone Program being carried out by the Office of River Protection (ORP)
- The 200 Area Characterization Project being conducted by the Environmental Restoration Program
- Site and local-scale groundwater monitoring by the Hanford Groundwater Project being supported by the Environmental Restoration program.

The Composite Analysis activities will also be monitoring results of science projects related to contaminant and hydrogeologic mobility being supported under the Hanford Site Integration and the Environmental Management Science Program sponsored by the Offices of Environmental Management and Energy Research.

6.0 Other Operational Activities

The manual for DOE Order 435.1 (DOE 1999b) requires that other operational information be included in PA's and Composite Analyses. For the Composite Analysis, this information could include the final disposition and end states of waste facilities and sites.

6.1 Status

As mentioned in DOE (1999d), in some cases, the final disposition and end-states of the radionuclide inventory in waste and contained in closed facilities is not well defined. In the Composite Analysis, estimates of the inventory and its location were needed. Thus, when using the end-state assumptions and calculated total inventory generated in these facilities, it must be determined and included in future analyses where that inventory will reside at the time of Hanford Site closure. Because that time is sufficiently far away, several DOE programs have not developed an understanding of their inventories and end-states and where they will finally reside. Final disposition of the chemical separations facilities and the reactors currently in the 100 areas, and residuals that will be left in single-shell and double-shell tanks, represent significant examples of these types of facilities. The Composite Analysis activity intends to maintain close ties with projects focused on making these decisions and will incorporate new data and information on end-states and inventories as they become available.

Another major observation of the first iteration Composite Analysis is the separation in time of two release episodes. The first is the result of liquid discharges and tank leaks, and the second is the result of dry disposals. Confidence in this finding relies on the waste and its protective barriers and on estimates of contaminant migration and fate in the vadose zone. To a significant extent, confidence that dry disposals since 1988 will not release to the water table for hundreds of years relies on our confidence in engineered waste forms and barriers to infiltration and leaching. The following assumptions were made:

- Any large contributions to the key mobile nuclide inventories of the solid waste burial grounds will be detected before acceptance of the waste, and such waste would be placed in a high-integrity waste form (e.g., mixed with a waste form material such as grout) or placed in a high-integrity container

- Engineered systems such as the double liner and surface barrier of the ERDF will function to specifications

- Engineered surface barriers placed over other wastes will perform to their design standards

- The TWRS ILAW will meet performance specifications that have been the basis of its simulation in this analysis.

Confidence in the results of this and future Composite Analyses depend on efforts that justify the assumptions regarding the waste handling protocols, waste form performance, engineered barriers, and infiltration rates.

Increased confidence in long-term aspects of contaminant release and migration implies greater confidence in the performance of surface covers and protective barriers. Covers and barriers are included in disposal facility design to control or limit a number of impacts including intrusion by plants, small mammals, and humans, and especially the infiltration of water into the waste. Not all wastes will require the same cover or barrier. Consequently, a graded approach to barrier design is needed. An understanding of the performance of the various design features or components of typical covers and protective barriers will enable DOE programs to incorporate into their designs only those cover features essential to the long-term performance of their waste. Studies should quantify the roles of surface soils, capillary interfaces between layers, climate variability, and plant dynamics in determining infiltration through the cover. Because barriers are assumed to function for decades and centuries, studies should seek to quantify the long-term durability of the components of typical covers and protective barriers. Studies should also quantify the potential for water to move laterally from the edge of the cover or barrier toward the waste form. This redistribution of water beneath the cover system may result in leaching of deep waste deposits including liquid discharge sites. Studies may show that covers have an influence over a finite depth and that their ability to reduce infiltration rate or recharge in the deep vadose zone is mitigated by the layering of natural sediment deposits that spread surface infiltration laterally. Certainly, it will be important to fully understand and quantify infiltration rates applicable both before and after final covers are applied to waste sites.

6.2 Plans

The Composite Analysis activity will interact closely with ongoing programs dealing with the development of final disposition and end-states of major waste facilities and waste sites. These include:

- Inventory-related task within the Integration Program that will provide holistic inventory estimates for use the System Assessment Capability element.

- New-disposed and revised projected waste inventories from
  - 200 East and West Solid Waste Burial Grounds operations
  - ERDF operations

- Potential revised projected tank waste inventories that will be:

  - Lost during sluicing during the tank retrieval process

  - Left in place as residuals in single-shell and double shell tanks

  - Disposed at the ILAW disposal facility

  - Disposal as a separate waste forms or secondary waste streams originating from the tank waste vitrification plant.

Initial estimates of the SAC inventory will be developed in FY 2000 for use in the initial calculations performed by the SAC in FY 2001. These estimates will assist the Composite Analysis activity in

development of inventories needed for the bounding sensitivity analysis that will be performed in FY 2001 (see Appendix C). These inventory estimates will continue to be refined with input from waste management, environmental restoration, and tank closure programs, and inventory estimates being developed by the science and technology elements of the Integration Program over the next several years for use in subsequent versions of the SAC.

The Composite Analysis will rely on ongoing barrier studies being conducted by Waste Management and the Environmental Restoration program and the ILAW program of the Tank Closure Program to provide new relevant data and information on engineered barrier design and performance. The Composite Analysis activity will also maintain an awareness of key results of barrier programs being supported by EM-50.

7.0 Interface and Integration Activities

The manual for DOE Order 435.1 (DOE 1999b) requires that the Composite Analysis activity monitor information that may alter the conceptual model(s) used in the Composite Analysis. As noted in the Section 1.3, Related Hanford Site Activities, a variety of Hanford Site activities could provide this type of information.

7.1 Status

The Richland Operations Office (Bauer 1997) set up the Hanford Groundwater/Vadose Zone Integrated Project to coordinate and integrate the various activities at the Hanford Site dealing with the vadose zone, groundwater, and river media that might be impacted by Hanford Site operations. The Composite Analysis activity has active contacts in many of the Integration Program's major activities, including:

- 200 Area Remediation
- Characterization of Systems
- Data Management
- Hanford Groundwater Program
- System Assessment Capability
- Science and Technology.

In addition, the Composite Analysis maintains close coordination with the activities not strictly under the Integration Program's control, including the ILAW PA activity, the Tank Farm Vadose Zone Characterization Program, and the Solid Waste Burial Ground PA activity.

7.2 Plans

The Composite activity will stay fully involved with the Hanford Site Integration Project activities. Formal integration teams have been set up in many areas. The Composite Analysis activity staff are active members in many of them, including the teams on System Assessment Capability development and implementation, Characterization of Systems, and the Hanford Groundwater Project, specifically the ongoing development and maintenance of site-wide groundwater modeling, the Science and Technology elements, and the development of vadose zone numerical code criteria and selection.

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Appendix A

DOE Guidance on PA/CA Maintenance

Appendix A

DOE Guidance on PA/CA Maintenance

The following text is quoted from the *Implementation Guide for use with DOE M 435.1-1* (DOE 1999c). The text in bold also appears in the **Radioactive Waste Management Manual** (DOE 1999b) and are the actual requirements for maintaining a performance assessment. Further guidance is in *Maintenance Guide for U.S. Department of Energy Low-Level Waste Disposal Facility Performance Assessments and Composite Analyses* (DOE 1999d).

IV. P.(4) Performance Assessment and Composite Analysis Maintenance. The performance assessment and composite analysis shall be maintained to evaluate changes that could affect the performance, design, and operating bases for the facility. Performance assessment and composite analysis maintenance shall include the conduct of research, field studies, and monitoring needed to address uncertainties or gaps in existing data. The performance assessment shall be updated to support the final facility closure. Additional iterations of the performance assessment and composite analysis shall be conducted as necessary during the post-closure period.

Performance assessments and composite analyses shall be reviewed and revised when changes in waste forms or containers, radionuclide inventories, facility design and operations, closure concepts, or the improved understanding of the performance of the waste disposal facility in combination with the features of the site on which it is located alter the conclusions or the conceptual model(s) of the existing performance assessment or composite analysis.

Objective

The objective of these requirements is to ensure that performance assessments and composite analyses are updated as appropriate, whenever changes in their bases (assumptions, parameters, etc.) are contemplated or effected in order to maintain the validity and effectiveness of the controls which are based on the performance assessment and composite analysis.

Discussion

As discussed in Section I.2.F. (15) of the guidance for Chapter I, General Requirements, since a low-level waste disposal facility will be in operation for many years, and waste receipts and knowledge concerning the disposal facility environs could change, maintaining the performance assessment and composite analysis through a regular schedule of evaluations is required by the manual.

The performance assessment provides a means whereby the long-term efficacy of the disposal facility is evaluated and provides input to disposal facility design, operational requirements, and waste acceptance

criteria. The composite analysis is a planning tool to ensure that low-level waste disposal, in consort with other activities at the site, is not likely to compromise future radiological protection of the public. Because the performance assessment and composite analysis results are projections based on estimated waste and facility characteristics, they are technically uncertain. A maintenance program is needed to, over time, improve confidence in the results of the analysis and in the long-term plans for protecting public health and safety. Through the conduct of an assessment maintenance program, site operators can technically justify reducing the conservatism in the analysis based on acquiring data which support revising the analyses. The results of the revised performance assessment and composite analysis can result in revised waste acceptance criteria which could result in a lessening of constraints on waste receipts, less costly remediation alternatives, or in revised land-use controls.

Acquisition and consideration of field data represents a necessary component of the maintenance program. Performance assessment and composite analysis development and refinement represents a continuous process during the operational life of a disposal facility. Over the lifetime of the disposal facility, the performance assessment and composite analysis must be maintained and upgraded as additional information about the waste, environmental setting, and site is obtained. At closure of the disposal facility, a final performance assessment which analyzes all of the waste that has been disposed must be prepared and approved. During the post-closure period, it may also be necessary to revise the performance assessment and composite analysis according to the criteria stated above.

As discussed above, the improvement of performance assessments, the addition of the composite analysis to the required evaluations of low-level waste disposal facilities, and their reviews and approvals has been the aim of much of the improvements to low-level waste management resulting from Defense Nuclear Facilities Safety Board Recommendation 94-2. Similarly, maintenance of performance assessments and composite analyses has also been modified to improve the upkeep of the analyses and controls based on the assessments. Consequently, detailed guidance on maintaining performance assessments and composite analyses is being developed for inclusion in DOE G 435.1-3, Maintenance Guide for U.S. Department of Energy Low-Level Waste Disposal Facility Performance Assessments and Composite Analyses. The Maintenance Guide will need to be consulted for additional detailed discussions of the maintenance of performance assessments and composite analyses once issued.

Compliance with this requirement is demonstrated by the implementation of a site-specific performance assessment and composite analysis maintenance program that includes research projects, field studies, and the results of monitoring to update the analyses.

A determination of the continued adequacy of the performance assessment and composite analysis shall be made on an annual basis, and shall consider the results of data collection and analysis from research, field studies, and monitoring.

Annual summaries of low-level waste disposal operations shall be prepared with respect to the conclusions and recommendations of the performance assessment and composite analysis and a determination of the need to revise the performance assessment or composite analysis.

Objective

The objective of these requirements is to ensure that the bases of the performance assessment and composite analysis (e.g., assumptions, parameters, waste inventory) remain valid and to ensure that results of testing, research, and development, and monitoring are considered in this determination and summary.

Discussion

Because the analyses in the performance assessments and composite analyses are based on projections of waste receipts and parameter values that predict site behavior, annual summaries of actual disposal operations that include actual waste receipts and results of site research projects and monitoring, can assist in calibrating the performance assessment and composite analysis to be more accurate as the life of the facility goes on. The annual summaries are to tie the annual summaries to the conclusions of the performance assessment and composite analysis, and determine whether they continue to be the correct conclusions. As more and more of these annual summaries are factored appropriately into the maintenance of the performance assessment and composite analysis, the more the results are based on actual facility performance, and the more the conclusions can be relied on to provide a reasonable expectation that the performance objectives will continue to be met.

Performance assessment and composite analysis maintenance includes the routine review and revision, as appropriate, of the analyses. Reviews provide a mechanism for routine assessment of the controls derived from the analyses on waste disposal, source remediation, or land-use controls so that potential problems are identified and managed. The revisions ensure that there is cohesive documentation providing a reasonable expectation of meeting the performance measures. This use of the analyses is similar to the use of a safety analysis report. The assumptions and analyses in the performance assessment are used to establish a performance envelope and are translated into administrative and engineering controls (e.g., procedures, waste acceptance criteria, designs, land-use controls).

The reviews should include an assessment of relative test, research and development, and monitoring data that may have been obtained. This part of the review is two-fold. First, it ensures that the conceptual model(s), assumptions, parameters, etc. remain valid. Second, it enhances confidence in the model results and may result in a lessening of the degree of conservatism in the analyses. The annual reviews should be documented and retrievable.

As discussed above, the improvement of performance assessments, the addition of the composite analysis to the required evaluations of low-level waste disposal facilities, and the reviews and approvals for these analyses are among the improvements to low-level waste management resulting from Defense Nuclear Facilities Safety Board Recommendation 94-2. Similarly, maintenance of performance assessments and composite analyses has also been modified to improve the upkeep of the analyses and controls based on the assessments.

Compliance with this requirement is demonstrated by a documented process that results in annual summaries of the low-level waste disposal operations and a determination of the continued adequacy of the analyses.

Supplemental References

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Appendix B

Format and Contents of Annual Summary

Appendix B

Format and Contents of Annual Summary

Overview

DOE M 435.1-1 IV.P.3(c) states that "Annual summaries of low-level waste disposal operations shall be prepared with respect to the conclusions and recommendations of the performance assessment and composite analysis and a determination of the need to revise the performance assessment or composite analysis." To comply with this requirement, the Field Element Manager shall prepare an annual summary for each composite analysis and submit the summary to Headquarters. The annual summary should be prepared by summarizing the information and conclusions from the annual determination for the previous year. The annual summary should include the information described in the following sections.

Assessment of Composite Analysis Adequacy

The annual summary report is to provide a summary of the conclusions drawn from the annual determination made by the Field Element Manager for the review period (generally the previous year). The summary should include a discussion or description of relevant factors, if any, that may have challenged or supported the determination of composite analysis adequacy.

The annual summary report should contain a summary statement as to whether the information reviewed as part of the annual determination resulted in any change to the conclusions of the composite analysis (i.e., whether, in light of the new information reviewed, dose to hypothetical future members of the public is expected to be below applicable limits and constraints). This statement should reflect one of four possible scenarios based on the annual review:

- there is no change to the conclusions of the composite analysis;
- the conclusions remain valid but the new information indicates less conservatism in the results than previously believed;
- the conclusions remain valid but the new information indicates more conservatism in the results than previously believed; or
- the conclusions are no longer valid (i.e., doses to hypothetical future members of the public may exceed applicable limits and constraints).

The general basis for the statement concerning changes to the composite analysis conclusions should be presented. The basis may include a summary of supporting data, but should not include a detailed presentation of data. This section of the annual summary should indicate whether, based on the above information, it would be necessary to revise the composite analysis.

Source Terms

The Field Element Manager should include an assessment of the potential sources of radioactive material, other than the low-level waste disposal facility (the low-level waste disposal facility will have been addressed in the performance assessment annual summary). The assessment should summarize the source term information reviewed during the annual determination. The primary purpose of this section of the annual summary is to inform Headquarters of changes to the sources of radioactive materials considered in the composite analysis. These changes could include:

- deletion of sources considered in the composite analysis;
- addition of new sources not considered in the composite analysis;
- changes to existing sources (e.g., completion of remedial activities at source that is CERCLA site); or
- availability of new information that reduces uncertainty in characteristics of existing sources.

The annual summary report should present these changes and describe their significance with respect to the results and conclusions of the composite analysis.

Monitoring and Research and Development Results

The monitoring results reviewed as part of the annual determination (see Section 3.1.3) should be identified, summarized, and interpreted. The interpretation should address whether the results indicate that the conceptual model(s) and data used for the composite analysis are still applicable. Any changes to the conceptual model(s) indicated by the monitoring results should be identified and their significance with respect to the results and conclusions of the composite analysis should be discussed. Monitoring results that are significantly different than data used in the composite analysis should also be identified and the significance of the differences discussed.

The annual summary should similarly present a summary of the research and development efforts that were conducted, the research and development results that were evaluated, and an interpretation of the significance of these results. Results that are specifically directed toward the low-level waste disposal facility will be evaluated in the annual summary for the performance assessment, and should not be addressed in this section. To assist Headquarters with tracking the status of low-level waste research and development implementation efforts, the research and development that was reviewed should be categorized as follows:

- research and development contained in the Site-wide Radioactive Waste Management Plan;

- on-site research and development not contained in the Site-Wide Radioactive Waste Management Plan

- off-site research and development contained in the Center database; or

- other off-site research and development efforts.

The annual summary should contain an evaluation of the significance of the research and development results with respect to the conclusions of the composite analysis. The evaluation should indicate whether the results indicate a change to the conclusions of the composite analysis, and whether the results indicate more or less conservatism in the composite analysis results.

The summary of results should be presented in such a manner as to facilitate updating the research and development planning process. Specifically, the presentation should allow easy comparison of the results with the data gaps and uncertainties previously identified during preparation and review of the composite analysis. The degree to which identified data gaps and uncertainties have been addressed by research and development activities completed to date should be identified. The annual summary should also provide a summary of the status of on-site research and development efforts associated with the composite analysis. The status should identify those research and development efforts completed during the previous year, those that are ongoing, those that will be started during the next year, revised priorities for research and development, and future efforts that will be included in Project Baseline Summaries to be submitted to Headquarters.

Summary of Changes

This section is to summarize changes affecting the composite analysis that have occurred over the past year. This would include changes to expected future conditions, such as site land-use plans or remediation plans. The annual summary should also describe changes made as a result of special analyses (see Section 3.4).

This section should also discuss changes related to monitoring and research and development. Specifically, this discussion should include the status of information needs (e.g., data gaps, uncertainties) identified in the composite analysis and previous annual reviews. The status of information needs should be categorized as follows:

- previously existing information needs that have been satisfied by monitoring and research and development efforts completed during the previous year;

- previously existing information needs that are no longer relevant due to changes in source terms, land use, site plans, or other conditions; or

- new information needs identified as a result of the annual review, including those resulting from changes in site conditions.

Recommended Changes

This section of the annual summary is to advise Headquarters of planned or contemplated changes in relevant site programs that could affect the composite analysis and changes in the composite analysis maintenance program. The subjects should be the same as covered above in Summary of Changes (Section 3.2.4), but should be forward-looking. Implementation of these recommended changes does not require Headquarters approval unless the changes affect areas that are conditions for approval of the composite analysis.

The discussion of recommended changes should include the expected significance of the changes with respect to the composite analysis results and conclusions. If needed to illustrate the impacts of specific changes on composite analysis results, the discussion should reference the results of the composite analysis sensitivity/uncertainty analysis. If significant changes to the results or conclusions are expected, the summary should recommend whether or not the composite analysis should be revised.

This section should also address recommended changes to monitoring and research and development activities associated with the composite analysis. This should include expected changes in information needs and the resulting changes in activities needed to meet information needs. Any recommended changes to monitoring or research and development activities that are conditions of approval of the composite analysis should be highlighted, as these will require Headquarters approval.

Composite Analysis Revisions

DOE M 435.1-1 IV.P.(3)(a) requires revision of the composite analysis when changes in waste forms or containers, radionuclide inventories, facility design and operations, closure concepts, or improved understanding of the performance of the waste disposal facility in combination with the features of the site on which it is located alter the conclusions or the conceptual model(s) of the existing composite analysis. The annual determination described in Section 3.1 is designed to identify conditions that would necessitate revision of the composite analysis. The annual summary described in Section 3.2 will identify specific conditions expected to result in changes to the conclusions or conceptual model(s).

A composite analysis revision is to include updated information (e.g., land use plans, results from monitoring and research and development), revised analyses, new models, changes in expected radionuclide inventories or other items affecting calculation of results. Consistent with the use of a graded approach, the form of the composite analysis revision can range from a simple amendment to the composite analysis to a resistance of the composite analysis document. If an amendment to the composite analysis is used, there must be a clear interpretation of how the information in the amendment relates to the original composite analysis and what it means relative to the conclusions reached in the composite analysis. In addition to submitting the composite analysis revision to the Deputy Assistant Secretary for Waste Management (or the Deputy Assistant Secretary for Environmental Restoration for low-level waste disposal facilities that are CERCLA sites), the Field Element Manager is also responsible for ensuring the revision is distributed to other parties, as appropriate. Other appropriate parties include interested stakeholders, and selected Field Office and Headquarters staff.

In determining how best to revise the composite analysis, the Field Element Manager should consider how cohesive and readily understood the composite analysis is or will be following the revision. For example, the revision may involve redoing transport and dose assessment calculations based on new land use data (i.e., a new point of assessment). There would be no change to the conceptual models. In this case, it would be appropriate to prepare an amendment that presents the new data, the results of the revised analysis, and comparison of the new results to the dose limits and constraints. In another case, however, there could be substantial changes to site or facility characteristics that result in significant changes to the conceptual models. In this case, it would probably be appropriate to revise and reissue the entire composite analysis document. If a full revision of the composite analysis document is made, the annual determination (Section 3.1) is not necessary for the year the revision is made.

Upon receipt of a revised composite analysis, Headquarters staff must conduct a review and determine a course of action. Actions resulting from the Headquarters review may range from a memorandum to file acknowledging the receipt and acceptability of the composite analysis revision to the initiation of a more thorough and detailed review. Headquarters staff may request additional information from the Field Element Manager as needed to conduct the review.

Appendix C

Plans for Bounding Sensitivity Analyses for Sources Not Analyzed in Composite Analysis, Rev. 0

Appendix C

Plans for Bounding Sensitivity Analyses for Sources Not Analyzed in Composite Analysis, Rev. 0

The following text is a copy of a memorandum from R. D. Hildebrand (DOE/RL) to J. E. Rhoderick and W. E. Murphie (DOE/EM, co-chairmen of the Low-level Waste Disposal Facility Federal Review Group [LFRG]), dated October 13, 1999, which outlines plans and schedules for performing a bounding sensitivity analysis for sources not analyzed in Composite Analysis, Rev. 0.

RL-F-1325.6 (02/98)

United States Government **Department of Energy**

memorandum

Richland Operations Office

073707

DATE: OCT 13 1999

REPLY TO ATTN OF: GW/VZ:RDH

SUBJECT: COMPOSITE ANALYSIS FOR LOW-LEVEL WASTE (LLW) DISPOSAL AT THE 200 AREA PLATEAU OF THE HANFORD SITE – BOUNDING SENSITIVITY ANALYSIS

TO: J. E. Rhoderick, EM-35, HQ
W. E. Murphie, EM-42, HQ

The DOE Richland Operations Office (RL) is confident that we have analyzed the potential impact of over 90 percent of the source term at the 200 Area Plateau of the Hanford Site. Over the next two years RL will develop and supply inventory, transport and dose information on the PUREX tunnels, the chemical separations plant and the Comprehensive Environmental Response, Compensation, and Liability Act sites in the 200 Area that were not analyzed in the March 1998, "Composite Analysis for LLW Disposal at the 200 Area Plateau of the Hanford Site" (see attachment). We will provide an addendum to the composite analysis relating the potential impacts of these sources to previous composite analysis results. The addendum will be submitted to the LLW Waste Disposal Facility Federal Review Group by September 30, 2001.

If you have any questions, please contact me at (509) 373-9626.

R. D. Hildebrand

R. D. Hildebrand, Project Manager
Groundwater/Vadose Zone

Attachment

cc w/attach:
M. P. Bergeron, PNNL
M. J. Graham, BHI

Current Hanford Site Plans for Response to LFRG Review Conditions Associated with Composite Analysis Acceptance

As a condition of the LFRG acceptance of the 200 Area Plateau Composite Analysis (CA), the Hanford Site needs to provide an addendum to the CA to the LFRG that addresses a bounding sensitivity analyses of the impact on the composite analysis results of the PUREX tunnels, the chemical separations plants and the CERCLA sites in the 200 Area not considered in the first CA.

Six canyon buildings, designed for the processing of special nuclear materials, are present on the 200 Area Plateau. Two of these plants, B Plant and the Plutonium-Uranium Extraction Plant (PUREX), are located inside 200 East Area. Four plants, T Plant, the Plutonium Finishing Plant (PFP), U Plant, and Reduction-Oxidation Plant (REDOX), are located inside 200 West Area.

The canyon buildings will be decontaminated and decommissioned under the CERCLA program. However, the various standards (e.g., for levels of contamination) and final disposition of the canyon buildings (e.g., whether cells are to be filled to provide stability and prevent subsidence, canyon buildings are to be demolished to grade, entombed, and covered with surface barriers to reduce infiltration) have not been defined.

In the case of each canyon building, the major radionuclide sources and waste within the retired plant will be removed, reduced, or stabilized. Radiological contamination within the facility will be removed or fixed in place. The canyon buildings are massive concrete structures, and concrete is an excellent waste form for sorbed radionuclides. Whatever structure is left in place will be stabilized (i.e., filled with soil, gravel, or concrete) and all services (such as water) will be disconnected. Retired filters will be isolated and stabilized to ensure a safe condition. It is likely that these areas and especially any remaining structure will be covered with a protective barrier to further isolate contamination from intrusion and recharge. Final disposals will be dry with minimal driving force to mobilize and transport radionuclides from facilities.

In the absence of an inventory including any mobile and long-lived radionuclides, and with the assurance that all contamination will be removed from or entombed in these substantial structures, these facilities are not analyzed in the first Composite Analysis. It appears unlikely that the canyon buildings will be a significant source of groundwater contamination, especially in the next 1000 years. When more is known about their final inventories (e.g., the quantity and radionuclides known to be fixed in place) and physical state (e.g., whether infiltration barriers will be constructed to minimize infiltration), they could be simulated as contaminated concrete monoliths. A sensitivity analysis case was evaluated to determine whether the cesium and strontium inventory in a canyon building and its retired filters could contribute to the composite dose.

The PUREX storage tunnels (#1 and #2) branch off from the PUREX railroad tunnel and extend southward from the east end of the PUREX plant. The tunnels are used for storage of mixed waste (e.g., spent equipment and tank cars) from the PUREX plant and from other onsite sources. The radiological

contamination in the tunnels consists primarily of uranium, transuranics, and/or mixed fission products. Currently, each storage tunnel is isolated from the railroad tunnel by a water-filled shielding door. No electrical utilities, water lines, fire detection or suppression systems, radiation monitoring, or communication systems are provided inside the PUREX storage tunnels. Material selected for storage is typically loaded on railcars modified to serve as both transport and storage platforms. Tunnel #1 is constructed of creosote-treated timber covered by roofing material and 2.4 m of earthen fill. Tunnel #2 is constructed of steel and reinforced concrete covered with 2.4 m of earthen fill.

Final closure of the PUREX storage tunnels will require the evaluation of alternatives. In general, these alternatives will involve either stabilizing the waste in the tunnels, or removing it and then stabilizing the tunnels (DOE 1 996c). Alternatives for stabilizing the waste in place include, but are not limited to, backfilling the tunnels, waste, and railcars with gravel, or grout, or a combination of the grout on the bottom and gravel on the top. All means of access to the tunnels would be permanently sealed. Then a final surface barrier that meets Resource Conservation and Recovery Act (RCRA) landfill cover requirements to prevent water from leaching the waste in the tunnels would be constructed. Thus, the tunnels would be left in a stable configuration resistant to consolidation and settlement. The waste would be left in either a grout matrix or a gravel cocoon. Because these options have excellent waste form performance characteristics in the vadose zone when overlain by a surface barrier that significantly limits recharge through the waste emplacement and because of the absence of an inventory including any mobile and long-lived radionuclides, the PUREX tunnels were also excluded from the first iteration of the Composite Analysis.

In development of source terms for other sites that will be remediated under CERCLA, the initial CA also identified a large number (364) of sites, facilities, and other unplanned release sites without inventory data or sufficient data and information to allow a rigorous analysis of their impacts. In the original analysis, it was assumed that sites with some radionuclide information in these data sources were the most significantly contaminated sites and that sites without inventory information were generally less significant sources. However, it is recognized that some sites, particularly those that received waste in the early years of Hanford operations, may have received significant quantities of radionuclides that are not recorded. We believe that additional examination of the qualitative information available for these sites will allow us to screen a number of these sources from further consideration. However, a significant number of these sites will need further analysis before credible bounding estimates of their inventories and their potential impacts can be evaluated.

At this time, other significant and substantive activities related to contaminant inventory development are being conducted within the context of the Groundwater/Vadose Zone Integration Project (Integration project) which can provide very relevant baseline information that could be used in the proposed bounding screening analysis. A comparison of the CA inventory estimates of the key radionuclides with other recent total site inventory estimates, provided in Table 1, provides a initial starting point for providing some bounding estimates of these inventories. With the exception of iodine-129, the current CA has analyzed the impacts of significant percentages of these independent inventory estimates. However, a considerable amount of effort is being undertaken as part of the Integration Project in the next few years to improve on these estimates and to utilize new approaches for allocation of these holistic inventories to specific sites and facilities.

During FY 2000, the inventory component of the systems assessment capability work element of the Integration Project will be developing a holistic inventory of all facilities on the Hanford Site for representative contaminants in very mobile (e.g., tritium, technetium-99), mobile (e.g., iodine-129, uranium), immobile (e.g. cesium-137, strontium-90), and very immobile (e.g., plutonium-239 and -240) categories. Data gathering for this inventory task will be initiated in May and completed in October. This activity will be followed by a history matching and data verification task in December.

The Science & Technology (S & T) task is focused on development of a probabilistic approach for estimating mass balanced based (i.e., holistic) inventories for the Hanford Site post closure setting. The scope of this S & T work is to extend the Hanford-Defined Waste (HDW) methodology for soil sites receiving process waste directly to soils, i.e., non-tank waste. The chemical separations conducted in the canyon buildings yielded waste streams that were discharged directly to ditches, ponds, chemical sewers, and cribs. These sites include the plant cooling water, chemical sewer, scavenging waste and surface spills. A probabilistic approach for estimating mass balanced (i.e., holistic) inventories for these sites are needed to support SAC and will be generated during FY 2000.

The S & T inventory task will work with the System Assessment Capability (SAC) to further define soil waste groupings in the Hanford Site post closure scenario and to identify the precision with which inventory for different radionuclides and chemicals will be needed for Rev. 0 and Rev.1 of the SAC.

Specific S & T activities now planned for FY 2001 include extension of the Hanford Defined Waste model to include improved estimates of contaminant waste streams and inventories from the PFP building, PUREX tunnels, solid waste burial grounds, graphic cores from production reactors, ancillary piping, and residues in the Canyon facilities. This effort will also identify and quantify inventories discharges to specific cribs and trenches receiving tank wastes. This FY 2001 activity is being planned in more detail at this time, and the date of its availability will become known within the month.

The Richland Operation Office request that the LFRG allow the currently planned inventory-related activities currently planned within the system assessment capability and science & technology elements of the Integration Project in FY 2000 and 2001 before this bounding screening is undertaken. RL expects results of the Integration project inventories will significantly improve current estimates of total site inventories and its allocation to major waste facilities thereby putting the Composite Analysis in a credible position to address the impacts of the sources in question. The SAC and S & T efforts will result in end products available for use by the CA team in the second quarter of FY 2001 to prepare the CA addendum. The work that will be performed will utilize the same analysis capabilities developed in the initial CA and will include the following analysis elements

- Development of bounding inventory estimates for the mobile constituents considered in the previous CA for PUREX Tunnels, canyon facilities, CERCLA sites and unplanned releases

- Simulation of groundwater transport analysis and estimation of dose

These analyses will be conducted during the second and third quarters of FY 2001. A draft addendum relating the potential impacts of the unanalyzed sources to previous CA results will be prepared and transmitted to the LFRG review team for review and comment at the end of FY 2001 (i.e., fourth quarter).

Table 1. Hanford Site Inventory Estimates, in Curies

	C-14	**C1-36**	**U**	**I-129**	**Se-79**	**Tc-99**
Agnew et al., 1997	4,190	–	2220	64.8	801	33,500
Kupfer et al., 1997	4,780	–	322	66.1	773	32,600
Schmittroth et al, 1995	769	–	296	66.1	1030	27,200
Kincaid et al., 1998	50,000	345	66,000	17.1	1050	24,900
Minus US Ecology	46,200	311	55,000	11.3	1050	24,800
Minus Reactor Cores	3,950	7.6	55,000	11.3	1050	24,800
Percent of Total Site Inventory Estimates Considered in Kincaid et al. (1998)						
Agnew et al., 1996	94	–	2480	17	131	74
Kupfer et al., 1997	83	–	17080	17	135	76
Schmittroth et al, 1995	514	–	18580	17	102	91

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