Department of Energy
Washington, DC 20585

April 30, 1996

The Honorable John T. Conway
Chairman
Defense Nuclear Facilities Safety Board
625 Indiana Avenue, N.W., Suite 700
Washington, D.C. 20004

Dear Mr. Chairman:

Enclosed is the "Guidance for a Composite Analysis of the Impact of Interacting Source Terms on the Radiological Protection of the Public from Department of Energy (DOE) Low-Level Waste Disposal Facilities" dated April 1996. This document is a deliverable due to you as detailed in Secretary O'Leary's Implementation Plan for Defense Nuclear Facilities Safety Board Recommendation 94-2, Revision 1, Task Initiative VII.B.2.

The composite analysis process, including an options analysis and recommendations for further action, as appropriate, will support the DOE decision-making process to ensure that continuing low-level waste disposal activities will not compromise future radiological protection of the public.

The Department has completed the action identified under this deliverable commitment and proposed closure of this commitment.

Sincerely,

John E. Baublitz

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for Environmental Restoration

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Deputy Assistant Secretary
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Enclosure

Guidance for a Composite Analysis of the Impact of Interacting Source Terms on the Radiological Protection of the Public from Department of Energy Low-Level Waste Disposal Facilities

April 1996

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1.0 Summary

Consistent with both the revised Implementation Plan[1] prepared in response to Recommendation 94-2 from the Defense Nuclear Facilities Safety Board (DNFSB) and the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA), DOE requires a composite analysis, in addition to either a Performance Assessment (PA) pursuant to DOE Order 5820.2A (Radioactive Waste Management) or risk assessments pursuant to CERCLA, for each active and planned LLW disposal facility. The composite analysis process, including an options analysis and recommendations for further action (see Section 3.6) will support the DOE decision-making process to ensure that continuing LLW disposal will not compromise future radiological protection of the public.

The composite analysis will estimate the potential cumulative impacts to a hypothetical future member of the public from the active or planned LLW disposal facility and other sources of radioactive material in the ground that may interact with the LLW disposal facility (not all sources of radioactive material on a DOE site, but all of those that could interact with the LLW facility). The projected total dose to a hypothetical future member of the public from these sources will be compared with the DOE primary dose limit of 100 mrem in a year plus ALARA (as low as reasonably achievable) set forth in DOE Order 5400.5 (and anticipated in 10 CFR 834). If the calculated dose exceeds the 100 mrem primary annual dose limit, an options analysis must be conducted to identify alternatives for reducing future doses to tolerable levels. If the calculated total dose exceeds a significant fraction of the limit, an options analysis will be prepared to consider the actions that could be taken to reduce the calculated dose and to consider the costs of those actions. For the composite analysis, "a significant fraction of the limit" is defined to be 30 mrem in a year; the 30 mrem in a year value is used as a dose constraint to ensure that no single source, practice, or pathway uses an extraordinary portion of the primary dose limit. Figure 1 portrays the process of comparing the results of the analysis with the primary dose limit and the dose constraint as well as the associated options analysis and ALARA assessment.

The composite analysis, as well as the facility PA for LLW disposal facilities developed under the DOE Order 5820.2A process, must be reviewed and approved by DOE HQ prior to issuing disposal authorization for the active or planned LLW disposal facility.

Environmental Restoration (ER) LLW disposal facilities, with Record of Decision's as of the date of issuance of this guidance, are required to complete a composite analysis according to the schedule in the Implementation Plan for DNFSB Recommendation 94-2, Revision 1. Future ER LLW disposal cells will have a composite analysis completed prior to ROD approval.

This effort will support development of a comprehensive environmental management systems approach that will ensure that DOE's 100-mrem primary annual dose limit is not exceeded and that possible doses to members of the public are reduced to levels as low as reasonably achievable (ALARA).

This effort will require close coordination among the Waste Management, Environmental Restoration, Facility Decommissioning, and Future Land Use Planning programs at each DOE site.

2.0 Introduction

In addition to LLW disposal and other activities conducted under the direct authority of the Atomic Energy Act, the Department is conducting remediation and waste disposal activities pursuant to CERCLA (In some instances, activities are being conducted pursuant to the Resource Conservation and Recovery Act - RCRA; such activities are subject to this guidance).

Disposal of LLW at Department sites is conducted under DOE Order 5820.2A and pursuant to CERCLA. DOE Order 5820.2A requires that Field elements prepare and maintain PAs to demonstrate compliance with the Order's performance objectives. The purpose of the PA is to provide the technical basis for development of siting, design, and waste acceptance criteria.

In implementing the CERCLA process for selecting remedies for cleanup of a site, various alternatives, which could include development of an environmental restoration LLW disposal facility, are evaluated against nine criteria. The selected alternative, at a minimum, must be protective of human health and the environment and meet applicable or relevant and appropriate requirements (ARARs). In selecting ARARs for proposed disposal cells, performance objectives of DOE Order 5820.2A are to-be-considered since DOE Orders are not promulgated pursuant to the Administrative Procedures Act. However, DOE, to meet its Atomic Energy Act responsibilities, must still demonstrate compliance with the substantive requirements of the Order.

The PAs now required for DOE LLW disposal facilities managed under DOE Order 5820.2A do not require the consideration of all residual radioactive material with the potential to impact the dose received by a hypothetical future member of the public. While cumulative risks from all sources and all pathways is evaluated under CERCLA, this composite analysis guidance is useful in providing a consistent approach for such evaluations.

The DOE requirements for radiological protection of the public (presently DOE Order 5400.5, which will soon be codified in 10 CFR 834) rely principally on:

(1) institutional control mechanisms such as land control,

(2) actual measurements or assessments conducted on a real time basis, and

(3) those protective or remedial actions that may be necessary to reduce doses and risks to low levels consistent with the ALARA process.

Although DOE Office of Environmental Management (EM) activities (LLW disposal, environmental restoration, facility decommissioning, and future land use planning) generally have little impact on current radiological dose to the public, the consequent residual radioactive material from such activities has potential for impacting future members of the public. Therefore, EM activities must be conducted in a manner that is not only protective of the public during facility operations, but also ensures that future members of the public will be protected from the aggregate of all residual radioactive material on a DOE site.

As indicated in the revised Implementation Plan[1], a comprehensive approach to ensure that EM activities will not compromise future radiological protection of the public is being developed. Pending implementation of the comprehensive approach, DOE will use a combination of assessments (performance assessments under DOE Order 5820.2A or CERCLA assessments) of active or planned LLW disposal facilities and composite analyses of the radiological impacts of other radioactive sources that potentially increase the dose to a future member of the public caused by the active or planned disposal facility. In the Implementation Plan[1], the Department commits to completing assessments and composite analyses for all active, or pending, LLW disposal facilities. The Department's intent is to use the same combination of assessments and composite analyses for future disposal facilities until the comprehensive environmental management systems approach is in place.

The composite analysis is a reasonably conservative assessment of the cumulative impacts from active and planned LLW disposal facilities, and all other sources of radioactive contamination that could interact with the LLW disposal facility to affect the dose to future members of the public. The composite analysis provides a suggestion of what could conceivably happen if DOE **did not** act to protect public health and safety and the environment. It provides information that DOE can use for planning. DOE can decide on the best ways to manage the total disposal system and expend resources. For example, DOE can identify those sources that most significantly contribute to total projected "dose", and decide on priorities for remediation, or decide on closure alternatives for active or inactive disposal areas. Hazard implications for some sources may be so low that little needs to be done beyond land control, minor maintenance, and monitoring.

The composite analysis of other sources is not required to be part of the PA or CERCLA process, but may be conducted separately. However, if it is advantageous, the composite analysis may be included in the DOE Order 5820.2A PA or CERCLA documentation or it may be prepared as an addendum. In either case, the migration of radionuclides released from the other sources and those released from the LLW disposal facility to a potential future point of public access must be analyzed and the resulting dose to a hypothetical future member of the public determined. Results of the composite analysis must be compared with the Department's 100-mrem primary annual dose limit for public protection and with the 30 mrem in a year dose constraint (see Section 3.6).

This document only provides guidance for the composite analysis and a format for the composite analysis report; it is not intended to provide guidance on the PA or CERCLA processes. The guidance and format is presented in seven topical areas:

1. Source term development
2. Performance analysis
3. Use of existing information and documentation
4. Sensitivity or uncertainty analysis
5. Interpretation of results
6. Options analysis and ALARA process
7. Composite analysis maintenance

DOE is also developing guidance on several other aspects of performance assessment[1]. Until DOE guidance is available, and consistent with a level of calculational effort appropriate for the composite analysis, analysts should consider existing recommendations of the Peer Review Panel (PRP) and the Performance Assessment Task Team (PATT)[2,3,4] for the preparation of LLW PAs. CERCLA risk assessments are developed in accordance with Environmental Protection Agency (EPA) guidelines[5,6,7]. Other models and procedures, used by the Nuclear Regulatory Commission (NRC), EPA and DOE, may be suitable for the composite analysis, particularly since some of the contributing sources may be soil contamination or stabilized contamination. Such sites may have already been evaluated using these approaches and the existing analyses, to the extent they are appropriate, should be used to reduce the costs of the composite analysis.

2.1 General Principles

The following general principles should be followed in the preparation of the composite analysis:

2.1.1 Data Quality Objectives Process

The Data Quality Objectives (DQO) Process[8,9] should be used as a flexible planning tool to prepare for and guide the composite analysis activities. Although the DQO process is frequently used to develop statistical sampling methods for sample collection and analysis, it is also useful in situations where samples will not be collected. The first iteration of the composite analysis (see Section 3.7) will use only information already at hand; no field samples will be collected for analysis (see Section 3.1). Reference 12 should be consulted as an illustration of the use of the DQO process in a situation where it was known at the beginning of the process that samples would not be collected and analyzed.

2.1.2 Point of Assessment

The composite analysis, including an options analysis and recommendations for further action (see Section 3.6) is required to support the DOE decision-making process to ensure that continuing LLW disposal will not compromise future radiological protection of the public. Thus, radiological doses are to be calculated at points that hypothetical future members of the public could reasonably be expected to access (i.e., points of assessment).

This differs considerably from the DOE Order 5820.2A PA and CERCLA processes which require assessment of impacts in the immediate vicinity of the waste.

The future point, or points, of public access assumed for the composite analysis must be defensible. Where available, land use plans or preliminary land use plans should be used to establish the assumed point of access; the plans should be referenced in the composite analysis report. If plans for land and facility use are not available, reasonably conservative assumptions should be made (and justified) to determine the point(s) of assessment for the composite analysis. The assumed point(s) of access should not necessarily correspond with the current DOE site boundary.

2.1.3 Time of Assessment

The Department intends to retain possession and/or control of land containing residual radioactive material as long as it presents a potential hazard to the public[10]. However, in spite of the great uncertainty in dose projections made over very long times, the composite analysis should present the maximum calculated dose to hypothetical future members of the public, within a time period of at least 1,000 years.

2.1.4 State of Facilities Being Assessed

The composite analysis is to evaluate the aggregate impact from residual radioactive material at DOE sites on the potential dose to future hypothetical members of the public. Therefore, for the composite analysis, it should be presumed that operations at the DOE site have ceased, all disposal facilities have been closed and all remediation and decontamination and decommissioning activities have been completed. In other words, the post-closure or post-operational state of the DOE site is to be assessed.

It may be necessary to presume remedial actions for sources of radioactive material for which the CERCLA process has not yet begun. No source of radioactive material should be excluded from the composite analysis because its future fate is uncertain (see Sections 3.1.1.4 and 3.3).

2.1.5 Level of Rigor of Analysis

The composite analysis does not need to be as detailed as the analyses for a LLW disposal facility PA or those done pursuant to CERCLA. However, the composite analysis must be credible. For the composite analysis, credibility will be ensured by two mechanisms.

First, in the composite analysis report, the analyst must clearly state and justify all assumptions. The analyst must also provide a clearly stated justification or rationale for each of the many choices that must be made in conducting the analysis. Such choices include, but are not limited to, the selection of radioactive sources to be included (see Section 3.1.1), the bases for estimation of source inventory and release rate (see Section 3.1.3), the conceptual model(s) for radionuclide transport, the selection of mathematical model(s) to be used, exposure scenarios to be considered, etc. The intent is for the composite analyses to be consistent in approach (i.e., each of the topical areas delineated in

the following guidance is considered on a site-specific basis, with justification provided for the details) without mandating uniformity in the details of the analysis.

Where appropriate, referencing prior work such as the facility DOE Order 5820.2A PA or CERCLA documentation or other relevant sources is encouraged to provide justification for assumptions or choices (see Section 3.2) and to take advantage of available data.

Second, the composite analysis will be reviewed and approved by DOE HQ. The review will ensure that the analysis is credible and will ensure that the composite analyses from around the DOE Complex are appropriately consistent.

2.1.6 Mathematical Models

Mathematical models used in the composite analysis should be fully described and justified. The type of model should be described along with a description of the theoretical basis for the model, the underlying assumptions and physical and chemical laws considered and the model uncertainties and limitations. The procedures used to verify the codes and methods for and results of model calibration should be described.

2.1.7 Degree of Conservatism in Analysis

Simplifying assumptions may be justified to reduce the cost of the analysis so long as the assumptions can be justified as being conservative (not likely to understate the calculated dose). However, the analyst should exercise caution against over-conservatism that may bias the options analysis.

2.1.8 Assessing Multiple LLW Facilities

A composite analysis is required for each active or planned LLW disposal facility on a DOE site. However, if a DOE site has more than one active or planned LLW disposal facility, it may be advantageous to prepare one composite analysis that includes all of the LLW disposal facilities as well as the other sources. In such a situation, disposal authorization[11] for each of the active and/or planned LLW disposal facilities included in the composite analysis will be contingent on approval of the composite analysis and the facility PA or CERCLA documentation.

2.1.9 Comparison with the Primary Dose Limit and Dose Constraint.

The composite analysis should establish a "base case" or "best estimate case" for comparison with the primary dose limit. This case should represent the most reasonable, yet conservative, forecast of the future state of the DOE site, based on current knowledge. It should include expected remedial activities. Where future disposition of a source of radioactive material is not known, or even expected, a reasonably conservative assumption (with justification) should be made.

The results of the base case should be compared with the dose constraint (see Section 3.5). If the base case results exceed 30 mrem in a year, an options analysis (see Section 3.6) should be done.

2.2 Composite Analysis Report Format

To ensure a consistent approach for the composite analysis (see Section 2.1.4), the composite analysis report should follow a standard format.

Summary and Conclusions

Identify the active or planned LLW disposal facility being analyzed. Summarize the results of the composite analysis. State the conclusions of the composite analysis, including whether an options analysis (including an ALARA assessment, as appropriate) was needed.

Introduction

Identify the active or planned LLW disposal facility under consideration. Briefly describe the facility and its past, present, and expected future operations. Describe the facilities location on the DOE site with respect to the other sources of radioactive material that may impact the performance of the LLW disposal facility.

Use of Data Quality Objectives Process

Describe how the DQO process was used. As appropriate, present flow charts, etc., that illustrate the use of the DQO process.

Source Term Development

Describe the sources of radioactive material on the DOE site. State the sources that were selected to be likely to contribute to the dose from the LLW disposal facility received by a hypothetical future member of the public. Provide the rationale for the selection. Provide justification for excluding any sources from the analysis. Provide the bases, with justification, for estimating the source term (radionuclide inventory and release rate) for each source to be included, as well as the estimated source terms. See Section 3.1.

Performance Analysis

Describe the methodology (data, conceptual models, mathematical models, etc.) selected to assess the potential migration of radionuclides from the various sources to the selected point(s) of assessment, and justify the selection. Describe the exposure scenarios selected for the dose calculations and justify the selection.

Describe the analyses conducted and present the results of analyses. See Section 3.3.

Sensitivity or Uncertainty Analysis

Describe the sensitivity or uncertainty analyses conducted. The analyses should be focused on future land use and environmental remediation alternatives. Provide justification for the selection of the cases analyzed. Present the results of the analyses. See Section 3.4.

Interpretation of Results

Discuss the results of the analysis in comparison with the primary dose limit and the dose constraint, considering the sensitivity or uncertainty analysis results. Provide an interpretation of the results. State whether the results indicate the need for an options analysis. If an ALARA assessment is conducted, include the assessment in this section of the report. See Section 3.5.

Options Analysis

If an options analysis is required, use the format described in Appendix 2. See Section 3.6.

3.0 Guidance

The following sections provide guidance for the composite analysis.

3.1 Source Term Development

To develop the source term, two steps are necessary. First, the sources of radioactive material in the ground that may contribute to the dose from the active or planned LLW disposal facility received by a hypothetical future member of the public must be identified. Second, a radionuclide source term (radionuclide inventory and release rate) for each source must be estimated. Each step is discussed below.

For the first iteration of the composite analysis (see Section 3.7), existing information (i.e., process knowledge, site history, etc.) must be relied upon to identify potential sources. Exploring for sources by field sampling or other methods, or collecting samples for analysis to use in source term estimation, will not be done.

3.1.1 Selecting Sources to Analyze

The composite analysis is an assessment of the total potential dose to a hypothetical future member of the public from the LLW disposal facility and all other potentially contributing sources of radioactive material in the ground. Background (natural radioactive material and global fallout from past nuclear accidents and weapons tests) as well as medical sources, and consumer products should not be included. Thus, in addition to LLW disposed after September 1988 and waste forecasted to be disposed, the composite analyses must account for LLW disposed before September 1988 as well as other radioactive sources.

Due to the varied situation at each DOE site, this Section is only intended to illustrate the process of selecting the radioactive sources to be considered. The composite analysis for each active or planned LLW disposal facility should document the process of determining the other source terms to be considered and should provide justification for excluding any source terms from analysis.

In the future, land controlled by DOE may be less extensive. Future uses of land outside of these smaller, controlled areas may involve practices that could, over the lengthy times

considered, affect the sources to be analyzed or the migration of radionuclides from certain sources. Land-use controls or other mitigative actions may be required. See further discussion in Section 3.3.

In Appendix 1, a figure is presented and discussed to illustrate the process of deciding the radioactive sources to be included or excluded in the composite analysis.

3.1.1.1 Pre-1988 LLW

If the active LLW disposal facility was in operation prior to 9/26/88 (the effective date of DOE Order 5820.2A), waste disposed before 9/26/88 must be considered as a source in the composite analysis.

3.1.1.2 Other LLW Disposal Facilities

Other active LLW disposal facilities and any planned low-level (or mixed low-level) waste disposal facilities must be considered as potential sources. Facilities that are expected to be developed (i.e., those in the DOE Five-Year Plan) should be considered; potential disposal facilities, such as those identified conceptually in the Programmatic Environmental Impact Statement (PEIS) or by the Federal Facilities Compliance Act (FFCA) Disposal Working Group, but not yet actually planned, need not be considered. Inactive or closed LLW disposal facilities must also be considered as potential sources.

3.1.1.3 TRU and Alpha LLW

Transuranic (TRU) waste, suspect transuranic waste, or buried transuranic-contaminated waste (DOE 5820.2A,II.3.i) must also be considered as potential sources unless a decision has been made to remove the waste. If the eventual disposition of such waste is uncertain, the composite analysis could consider a few cases, based on potential actions, to bound (estimate the maximum impact) the eventual disposition of the waste (see Section 3.4). Alternatively, a conservative assumption, such as leaving the entire TRU inventory in place, could be made to facilitate completing the first iteration of the composite analysis (see Section 3.7).

TRU waste in the ground in a storage configuration which DOE plans to recover for shipment to a transuranic waste repository should not be included as a potential source. However, LLW generated in recovery of TRU waste must be considered as a potential source (assuming that it is to be disposed in the LLW disposal facility), as must residuals from the recovery (assuming that radionuclides released from the residue would interact with those released from the LLW disposal facility). Low-level waste containing transuranic radionuclides (commonly referred to as 10 to 100 nCi/g waste, or alpha LLW) must be considered as a potential source as well.

3.1.1.4 Environmental Remediation Activities

Radioactive material in the ground (or ground water) as a result of DOE operations, such as liquid waste disposal by cribs, ponds, seepage basins, etc. must be considered as potential

sources. Radioactive material in the ground from spills or leaks from DOE operations, or residues from remediation of such sources, must also be considered as potential sources.

If remediation plans are not certain, a few cases, based on potential remedial actions, could be analyzed to bound the contribution (estimate the maximum contribution) from each source (see Section 3.4). Alternatively, a conservative assumption (such as no remediation) could be made to facilitate completing the first iteration of the composite analysis (see Section 3.7).

If remediation plans have been decided (such as in a CERCLA Record of Decision or by some other means, where cleanup levels are negotiated and accepted by regulatory authorities), or if the remediation has been accomplished, the effect of the remediation (reduction of infiltration by capping, removal of some of the radioactive material, treatment of radioactive material left in place to reduce its mobility, etc.) should be included in the estimation of the source term. Real property released for public use[10] (e.g., industrial, commercial, recreational, residential, etc.) need not be considered as a potential source (see Section 3.3), unless a potential use (such as irrigation) could impact the dose to a hypothetical future member of the public (see Section 3.4).

No source of radioactive material should be excluded from consideration in the composite analysis because its future fate is uncertain.

3.1.1.5 Facilities

Radioactive material in facilities (e.g., buildings) need not be considered as a potential source if decontamination and decommissioning (D&D) activities are expected to remove the radioactive material. However, if D&D activities are expected to leave some of the radioactive material in place, the residual radioactive material should be considered as a potential source unless the property is expected to be released for public use (see Sections 3.3 and 3.4). As noted in Section 3.1.1.4, radioactive material in the ground resulting from operations in facilities (leaks, spills, etc.) must be considered.

Radioactive material in below-ground storage tanks (or other modes of storage) also need not be considered unless the waste in the tanks (or some portion of it) is to be left in place. If the amount of radioactive material to be left in place is uncertain, a few cases could be considered to bound the eventual disposition (see Section 3.4). Alternatively, a conservative assumption (such as no remediation) could be made to facilitate completing the first iteration of the composite analysis (see Section 3.7).

3.1.1.6 Commercial Nuclear Operations

It may be necessary to consider sources of radioactive contamination from commercial nuclear operations, such as a commercial LLW disposal facility. Consistent with requirements in draft final 10 CFR 834[10], doses from non-DOE activities need be considered only when (1) the dose to individual members of the public from DOE activities exceeds 30 mrem in a year, and (2) the dose from the non-DOE activities also exceeds 30 mrem in a year to the same individuals. If the Part 834 requirements change before its promulgation, this guidance will be reconsidered as needed.

3.1.2 Excluding Sources From Analysis

Sources of radioactive material may be excluded from further consideration if the exclusion is technically justified. The rationale for excluding any source from analysis must be stated and justified. Criteria for exclusion include (but are not limited to) the following:

3.1.2.1 Proximity or Source Inventory

The distance from the source to the place where the radionuclides could impact future members of the public may be sufficiently long that dispersion in the environment and/or radioactive decay during transit would reduce the contribution from the source to a small fraction of that resulting from the LLW disposal facility and other sources. Alternatively, the rate of radionuclide migration (e.g., through the vadose zone at arid sites) may be so slow that radioactive decay during transit would reduce the contribution from the source.

If the radionuclide inventory of the source is small enough that, given reasonable release mechanisms, the source could contribute only a very small fraction to the dose to a hypothetical future member of the public resulting from the LLW disposal facility and other sources, the source can be excluded.

If the source contains only radionuclides that have been shown to not contribute significantly to calculated doses (e.g., from radionuclide screening[4]), the source may be excluded.

3.1.2.2 Natural Barriers

Natural features of the environment may prevent radionuclides released from a source from contributing to the potential dose from the LLW disposal facility to a hypothetical future member of the public. However, because of the lengthy time-frame considered, it should be kept in mind that the efficacy of natural barriers may change over time; also, some uses of lands surrounding disposal areas may compromise the ability of natural barriers to keep sources of radioactive contamination from interacting (see Section 3.4).

Justification for excluding a source, based on natural barriers, should demonstrate a detailed and thorough knowledge of the subsurface flow conditions and geology, as well as the short- and long-term changes in climate and land use that could affect such barriers.

The analyst is also cautioned that distinction must be made between local and regional flow systems and their interaction.

Natural barriers that should be considered include (but are not limited to) the following:

3.1.2.2.1 Groundwater Divide

A groundwater divide which lies between the LLW disposal facility and another source may prevent migration of radionuclides released from the source to a potential future point of public access where a hypothetical future member of the public could be exposed from radionuclides released from the LLW facility.

3.1.2.2.2 Surface Stream Which Intercepts Groundwater

A surface stream which lies between the LLW disposal facility and another source, and which intercepts groundwater, may reduce or prevent migration of radionuclides released from the source to a potential future point of public access where a hypothetical future member of the public could be exposed from radionuclides released from the LLW facility. However, doses from use of the surface stream must be considered if the surface stream could reasonably be accessed by the public in the future.

3.1.2.2.3 Parallel Groundwater Flow Paths

Groundwater flow may be in one predominant direction. If so, and the LLW disposal facility is situated so that another source of radioactive material being considered is neither upstream nor downstream from it (i.e., the shortest distance between the LLW facility and the other source is in a direction approximately perpendicular to the groundwater flow direction), contaminants released from the source may not converge with those released from the LLW disposal facility. Thus, it may be justified to exclude the source from consideration. If, however, the point of assessment is at a distance (such that contamination plumes from the two sources could mix) or at a place (such as a river or stream) where radionuclides released from the two sources would converge, the source must be considered.

3.1.3 Estimating Radionuclide Inventory and Release Rate

For each source having a potential impact on the dose received by a hypothetical future member of the public from the LLW disposal facility, an estimate must be made of the inventory (identity and quantity) of the radionuclides in the source (including radioactive decay products) and their rate of release to the environment. Inventory information should be derived from process knowledge and existing records. Records that should be considered include waste disposal records or projections, production histories, effluent or environmental monitoring data, and any other information that may be relevant. References 12, 13, and 14 may be consulted as examples of the development of inventories for old LLW disposal facilities.

The rate of radionuclide release from the source to the environment must also be estimated. Release rates will depend on the physical and chemical form of the waste, the disposal unit design, waste packaging and other factors. Inventory data may provide information relevant to release rates. In many cases, it may be necessary to make conservative assumptions about waste and radionuclide characteristics that affect the release rate (packaging, waste form, solubility, etc.). In such cases, the assumptions should be clearly stated and justified. If mathematical modeling is used to estimate release rates, the physical and chemical mechanisms assumed should be clearly stated and justified (see Section 2.1.5).

Sources such as spills, liquid waste disposal facilities (such as cribs, ponds, seepage basins, etc.), and other sources of radioactive contamination in the ground may be the subject of remediation activities under CERCLA. If remediation plans are not certain, a few cases, based on potential remedial actions, could be analyzed to bound the contribution (estimate the maximum) from each source (see Section 3.4). Alternatively, a conservative

assumption (such as no remediation) could be made to facilitate completing the first iteration of the composite analysis (see Section 3.7). If remediation plans have been decided (such as in a CERCLA Record of Decision or by some other means where cleanup levels are negotiated and accepted by regulatory authorities), or if the remediation has been accomplished, the effect of the remediation (reduction of infiltration by capping, removal of some of the radioactive material, treatment of radioactive material left in place to reduce its mobility, etc.) should be included in the estimation of the source term. Reference 15 could be consulted as an example of developing a source term from such data.

For other sources, such as waste stored in underground storage tanks, plans for eventual disposition of the source should determine how the source is considered. If plans for the long-term disposition of such sources are uncertain, the composite analysis could present results of varying hypothetical cases. For example, one case could assume the removal of the entire radioactive content of underground storage tanks. Other cases could assume that some fraction of the radioactive material would be left in the tanks. Varying treatments of the residual waste to reduce the rate of release of contaminants to the environment could also be assumed (see Section 3.3).

In some cases, little information may be available for source term estimation. In such cases, process knowledge should be used to estimate (even if very roughly) an upper bound for the source terms to expedite completion of the first iteration of the composite analysis (see Section 3.7).

Many of the sources of radioactive material considered in the composite analysis will be managed through the CERCLA process as part of the sites environmental restoration program or will be managed by the site's D&D program. Thus, developing the source term for the composite analysis must be a coordinated effort between the Offices of Waste Management (EM-30), Environmental Restoration (EM-40), and Transition and Management (EM-60).

Quality control for developing source terms will be provided by documenting, in a defensible manner, the bases (assumptions, calculations, references, etc.) used in deriving the source terms.

3.2 Use of Existing Information and Documentation

If existing information can be used in part or in whole to provide the needed analysis under this guidance, the information can be extracted from the existing documentation or referenced. In either case, the information should meet all the elements of this guidance and be consistent with the technical approach presented. Any differences between the existing information in terms of this guidance should be identified and justified as to why it is valid in providing the demonstrations called for under this guidance.

3.3 Performance Analysis

Under DOE Order 5400.5, Radiation Protection of the Public and the Environment, DOE activities may not cause doses to members of the public from all exposure pathways, except for doses from radon isotopes and radon decay products, to exceed 100 mrem in a year. In

addition the ALARA process must be implemented for all DOE activities that cause public doses[16]. The public dose limits do not apply to doses from medical sources, consumer products, global fallout from past nuclear accidents and weapons tests, and naturally occurring radiation sources (unless the naturally occurring radiation sources were enhanced by DOE activity, in which case a case-by-case determination will be made). DOE 5400.5 will be replaced by 10 CFR Part 834[10].

The public dose limit applies only to members of the public. Thus, it applies only beyond the boundary of land controlled by DOE. Currently, land controlled by DOE extends to the boundary of the entire DOE site. However, the land controlled by DOE for purposes of radiation protection of the public should be assumed for the composite analysis to shrink in the future and should be consistent with site-specific plans required by DOE policy for land and facility use[17]. Site-specific plans for land and facility use should be referenced in the composite analysis. If plans for land and facility use are not available, reasonably conservative assumptions should be made (and justified) to determine the point(s) of assessment for the composite analysis (see Section 2.1.1).

Radiological release criteria for contaminated property are currently provided in DOE 5400.5 and are being promulgated as 10 CFR Part 834; eventually requirements in 40 CFR 196 will be applicable and adopted in 10 CFR Part 834. Real property released for public use need not be considered as a potential source in the composite analysis, even if the released property has some residual radioactive material, because the release criteria ensure that the dose from the released property could be only a small fraction of the primary dose limit. Released property may need consideration in the analysis as a non-DOE source if total doses from all DOE sources exceeds 30 mrem in a year and the doses from the non-DOE (e.g., released) property exceeds 30 mrem in a year.

The all-pathways analyses conducted for the composite analysis should be used to determine the maximum exposure to a hypothetical future member of the public outside of the land controlled by DOE. (Although in some complicated configurations, especially in the absence of information about other sources of radiation within a controlled area, a more conservative point of assessment might be selected for a given facility to provide greater assurance that total doses will not exceed the primary dose limit.)

DOE is committed to retain control of contaminated lands until they can be released under the provisions of DOE Order 5400.5 and, eventually, 10 CFR 834. However, in spite of the great uncertainty in dose projections made over very long times, the composite analysis should present the maximum calculated dose to hypothetical future members of the public, within a time period of at least 1,000 years. The total dose from all of the sources together, and from each source separately, should be reported as a function of time. Maximum calculated doses from different sources will likely not occur at the same time.

3.4 Sensitivity or Uncertainty Analysis

To facilitate interpretation of the results of the composite analysis, a limited sensitivity or uncertainty analysis should be carried out. The analysis should be limited to consideration of the sources other than the LLW disposal facility, and to land use controls, rather than an assessment of all parameters, assumptions, etc. The sensitivity or uncertainty analysis

should consider the impacts of reasonable alternative uses of land outside those areas assumed to be permanently controlled by DOE for radiation protection of the public. Some uses, such as large-scale irrigation, could influence the groundwater flow and consequently the performance of the disposal facility and the calculated impacts from all sources of radiation exposure resulting from DOE activities that may contribute to the future dose from the LLW facility that may be received by a hypothetical future member of the public. Land use restrictions or other mitigative measures may be required. This analysis should be coordinated with the site's Waste Management, Environmental Restoration, Facility Decommissioning, and Land-use Planning organizations.

The analysis should also include a consideration of the uncertainty in the estimate of source term (inventory and release rate) for each of the sources considered in the composite analysis. For those sources which are, or can reasonably be expected to be, the subject of remedial action under CERCLA, but for which a record of decision has not been rendered, varying remedial actions could be hypothesized for each source. Then, the effect of the remedial action (reduction of infiltration by capping, removal of some of the radioactive material, treatment of radioactive material left in place to reduce its mobility, etc.) would be included in the calculation of the dose resulting from the source. Alternatively, a conservative, bounding assumption could be made to assess the maximum impact of the source. Although remediation decisions for the other sources may be influenced by this composite analysis, final decisions will be made through the CERCLA process, consistent with DOE requirements, including the composite analysis.

3.5 Interpretation of Results

The total calculated dose to a hypothetical future member of the public in the base case must be compared with the DOE primary dose limit of 100 mrem in a year. Figure 1 illustrates the logic that should be followed in comparing calculated impacts with the dose limit. For the composite analysis, a dose constraint of 30 mrem in a year will be used.

The results of the base case should be compared with the dose constraint. If the base case results exceed 30 mrem in a year, an options analysis should be done.

If an ALARA assessment is needed, references 16 and 18 should be consulted for guidance on the assessment process.

It should be emphasized that a projection that the potential dose to a hypothetical future member of the public will exceed the primary dose limit at some time far in the future does not constitute a present-day noncompliance. Rather, it identifies a potential future problem that must be mitigated or corrected before it occurs. DOE 5400.5 requires (and 10 CFR 834 is expected to require) the use of the ALARA process, and in some cases the best available technology (BAT) process, in the selection of mitigative actions or controls. These processes and analyses should be considered in the options analysis discussed in Section 3.6.

3.6 Options Analysis and ALARA Process

The purpose of the composite analyses is to support DOE environmental management of a site. Although it is not being implemented specifically to comply with DOE 5400.5 (10 CFR Part 834 when final) it can support or satisfy the requirements in this directive to apply the ALARA process for protection of the public from radiation.

Consistent with international and national recommendations, the Department's radiation protection system encompasses two principal elements: dose limits and optimization. Dose limits constitute allowable or tolerable doses that are not to be exceeded under normal conditions. The 100 mrem in a year dose is the primary dose limit for protection of the public from all sources and pathways. The Department also employs dose constraints in the implementation of the radiation protection system. Dose constraints are set at a fraction of the primary dose limit and are typically established to ensure that no single source, practice, or pathway uses an extraordinary portion of the primary dose limit. Optimization is effectively the reduction of public doses to levels as far below dose limits or constraints as is practicable giving due consideration to collective impacts, costs, and other factors, using the ALARA (as low as reasonably achievable) process.

The composite analysis process incorporates the elements of the radiation protection system as benchmarks to aid environmental management. The composite analysis uses long-term projections of potential doses to support systematic environmental management of waste management and restoration sites. If the answer to the first decision criterion in Figure 1 is yes ("Is the total dose from the composite analysis > 100 mrem in a year"?), then it is an indicator of a future problem that must be corrected or mitigated before it occurs. In this case, the options analysis must be conducted to identify alternatives for reducing future doses (before they occur) to tolerable levels using the ALARA process.

If the answer to the first question is no, then the composite analysis is reviewed to determine if there is potential for exceeding the DOE dose constraint of 30 mrem in a year (decision criterion 2: "Does total dose from the composite analysis exceed 30 mrem in a year?"). If the answer is yes, then the options analysis is conducted and the alternatives analyzed under the ALARA process to determine what actions are reasonable to reduce public doses. The difference between a "yes" in the first and second decision criteria is that in the first case mitigating measures **must** be taken before the dose limit is exceeded while in the second case, an action **should** be taken but may be determined not to be warranted as a result of the ALARA analysis.

If the 30 mrem in a year dose constraint is not exceeded an options/ALARA analysis may still be warranted but it is not necessarily required. This determination is made in the third decision block ("Is an ALARA analysis warranted?"). This determination should be made using a series of conditions or criteria. At these low doses, the question to be answered is:

Will a quantitative ALARA assessment of the options identify cost-beneficial means of reducing dose; i.e., is the cost of a quantitative ALARA analysis potentially justified?

The following discussion provides criteria for determining if an ALARA analysis is warranted. The typical quantitative or semi-quantitative ALARA analysis assesses the cost-

benefit of a dose reduction by assigning a monetary equivalence to a dose reduction. The process is optimized when the cost of the action is less than or in the range of the monetary valuation of the dose. The monetary equivalence recommended for dose reduction by the Department is in the range from $1,000 to $10,000 per person-rem potentially avoided.

To use this criterion, an estimate of potential collective doses must be made. This estimate should be conservative but reasonably realistic (e.g., plausible worst case). The principal pathway of exposure from waste management is through the groundwater pathway. Therefore, a reasonable screening process is to estimate the potential use of the ground water at the point of assessment and the number of individuals that might be expected to be exposed (the critical group), and then to multiply the average dose to the critical group by the size of the critical group.

For example, in a situation where consumption of groundwater is the expected principal means of exposure, it could be assumed that a public drinking water supply system is installed at the point of assessment. The analyst could then assume that the drinking water supply system serves the same population as that of the present public drinking water supply system that is closest to the point of assessment.

At the maximum monetary valuation suggested by the Department, $10,000 per person-rem, a reduction of a collective dose of 100 person-rem would be valued at $1,000,000. Assuming it is estimated that the cost of an ALARA review of alternatives can be conducted for a small fraction of the $1,000,000 (less than 20%), than a possible dose reduction of 100 person-rem should result in a decision that a quantitative, or semi-quantitative, ALARA review is warranted. Similarly, if the projected collective dose is less than 10 person-rem, the valuation of this dose reduction is less than $100,000. It would not be reasonable to conduct a quantitative ALARA review, because the review itself could cost as much, or more, than the potential dose reduction is valued. Therefore, for situations where potential collective dose reductions are less than 10 person-rem, no quantitative ALARA analyses should be considered. In ALARA guidance being prepared to support 10 CFR Part 834, practical limits for temporal integration of collective doses is being considered.

There is no technical basis for limiting the integrating time; however, recognizing that an ALARA analysis is a decision-making tool and given uncertainties and intergenerational equity considerations, the Department believes that quantitative analyses beyond a few hundred years are not valuable in the decision-making process. Non-catastrophic impacts beyond this point should not be included in quantitative estimates because they can bias decisions. When they are considered it is essential that uncertainties be clearly addressed. Because projected impacts from waste disposal may not occur within the first 200 years, the integration period should be extended to 1,000 years, but no longer.

If an ALARA assessment is warranted, it is conducted as it would for those conducted if projected individual doses exceed the 100 mrem in a year dose limit or the 30 mrem in a year dose constraint. However, the complexity and scope of the ALARA analysis should be commensurate with the potential risks or dose that might be averted through the process.

The remaining portions of the process include the options analysis, the ALARA assessment, and the ALARA-based decision. In identifying the options, only alternatives that could significantly reduce the dose should be considered in detail. For example, if there are five different sources interacting in the area covered by composite analysis and two of the sources represented 90% of the dose, control alternatives should be considered for the significant sources only. If the LLW site is not a major contributor to the projected dose to the hypothetical receptor, then the LLW site design and waste acceptance criteria would likely be based on the DOE 5820.2A performance assessment and would likely not be influenced by the composite analysis.

The options for control or mitigation of the doses should then be assessed and compared and control alternatives selected consistent with the ALARA process and associated guidance. The ALARA process analysis will serve to justify and support the determination of reasonable action (or no action). In the case where the 100-millirem annual dose limit is potentially exceeded, "no action" is not an acceptable alternative. A mitigating or corrective action must be taken before the projected dose becomes an actual dose. Consideration may also be given to use of additional monitoring, data collection, or modeling to develop more realistic estimates.

Potential mitigating actions that should be considered include refining the analysis to reduce conservatism, improving the design of the LLW disposal facility, limiting the receipt of waste to be disposed in the LLW disposal facility or requiring waste form performance for waste to be disposed in the LLW disposal facility, and remediating the other sources (such as in-situ stabilization or capping, partial or full removal of the radioactive material, etc.). Optimizing the long-term land use boundary should also be considered. In an extreme case, termination of disposal in the LLW disposal facility may be considered to ensure meeting the primary dose limit; however, the costs and benefits of such an action should be considered along with other site-wide alternatives.

The options analysis should identify the preferred action and justify the choice. The justification should be based on the cost/benefit analysis conducted, the level of uncertainty inherent in the composite analysis, the number of CERCLA actions still to be completed on the site, and other factors. A description of the implementation of the preferred option should be included. The implementation plan can address inclusion of the composite analysis results in future CERCLA actions, into the Environmental Radiological Protection Plan required by 10 CFR Part 834, or into the future land use planning efforts at the site. The preferred option and the implementation plan for that option will be considered by headquarters in its review of the composite analysis.

An annotated outline for the options analysis is presented in Appendix 2. The options analysis should be submitted, along with the composite analysis, for Headquarters review.

Remedial activities, waste management operations, facility decommissioning, and land use planning must be coordinated to ensure that development of the options analysis considers all site activities.

3.7 Composite Analysis Maintenance

As indicated in the revised Implementation Plan[1], a comprehensive approach to ensure that waste disposal and environmental remediation activities will not compromise future radiological protection of the public is needed. Pending implementation of the comprehensive approach, DOE will use a combination of assessments (performance assessments under DOE Order 5820.2A or CERCLA assessments) of active or planned LLW disposal facilities and composite analyses of the radiological impacts of other radioactive sources that potentially increase the dose to a future member of the public caused by the active disposal facility. The Department commits completing assessments and composite analyses for all active, or pending, LLW disposal facilities. In the interim, it is the Department's intent to use the same combination of assessments and composite analyses for future disposal facilities until the comprehensive approach is in place to ensure evaluation of long-term radiological impacts.

Therefore, until the comprehensive approach is implemented, the composite analysis, as well as the facility PA or CERCLA documentation, must be maintained. As changes in any of the bases of the composite analysis occur, revision of the composite analysis should be considered. The composite analysis should be revised if the change(s) would result in the calculated base-case dose exceeding 30 mrem in a year. The revised composite analysis should be transmitted to DOE-HQ for review.

Bases that could change and precipitate another iteration (revision) of the composite analysis include, but are not limited to, the following:

Land Use

Projected DOE property boundary, use of DOE-owned property, or use of property adjacent to DOE-owned property

Source

A "new" source of residual radioactive material (one that was not included in the composite analysis)

Source Term

The inventory and/or rate of release of radionuclides from a source that was analyzed in the composite analysis

Environmental Transport

The understanding of the mechanisms and/or rates of radionuclide transport through the environment

4.0 References

1. IMPLEMENTATION PLAN, DEFENSE NUCLEAR FACILITIES SAFETY BOARD RECOMMENDATION 94-2, Conformance with Safety Standards at Department of Energy Low-Level Nuclear Waste and Disposal Sites, Rev.1, projected April 30, 1996 issuance.

2. DOE/LLW-93, Performance Assessment Review Guide for DOE Low-Level Radioactive Waste Disposal Facilities, October, 1991.

3. DOE/LLW-81, Recommended Format and Content for DOE Low-Level Waste Disposal Facility Performance Assessment Reports, April, 1989.

4. DOE/LLW-157 (Rev.1), Performance Assessment Task Team Progress Report, May, 1994.

5. U.S.Environmental Protection Agency, Risk Assessment Guidance for Superfund, EPA/540/1-89/002, 12/89.

6. "Guidance for conducting Remedial Investigations and Feasibility Studies under CERCLA", EPA/540/6-89/004, 1988.

7. 40 CFR 300, "National Oil and Hazardous Substances Pollution Contingency Plan".

8. "Guidance for the Data Quality Objectives Process", EPA QA/G-4, September 1994.

9. "Data Quality Objectives Process for Superfund: Interim Final Guidance", EPA 540-R-93-071, 1993.

10. 10 CFR 834, Radiation Protection of the Public and the Environment(draft final, 60 FR 45381, 31 August 1995).

11. Memorandum, T. P. Grumbly and T. J. O'Toole, Interim Policy on Regulatory Structure for Low-Level Radioactive Waste Management and Disposal, 7/21/95.

12. "A Comprehensive Inventory of Radiological and Nonradiological Contaminants in Waste Buried in the Subsurface Disposal Area of the INEL RWMC During the Years 1952-1983", INEL-95/0310, Rev. 1, August 1995.

13. "A Comprehensive Inventory of Radiological and Nonradiological Contaminants in Waste Buried or Projected to be Buried in the Subsurface Disposal Area of the INEL RWMC During the Years 1984 - 2003", INEL-95/0135, Rev. 1, August 1995.

14. "Performance Assessment for Continuing and Future Operations at Solid Waste Storage Area 6", ORNL-6783, February, 1994.

15. U.S. DOE, Fernald Area Office, Draft Final Feasibility Study Report for Operable Unit 5, Fernald Environmental Management Project, Fernald, Ohio, Remedial Investigation and Feasibility Study, Volume 3, Appendix H, Comprehensive Response Action Risk Evaluation for Operable Unit 5, March 1995.

16. Memorandum, R. F. Pelletier, Guidance for Implementation of ALARA Requirements for compliance with DOE 5400 Series Orders: For Interim Use and Comment., 3/14/91.

17. Memorandum, Secretary of Energy to Secretarial Officers and Operations Office Managers, Land and Facility Use Policy, 21 December 1994.

18. Yu, C., et al, Manual for Implementing Residual Radioactive Material Guidelines Using RESRAD, Version 5.0, Argonne National Laboratory, ANL/EAD/LD-2, 9/93.

Appendix 1 - Example of Selecting Sources to Analyze

Figure 2 shows a hypothetical active or planned DOE LLW disposal facility. The following provides an example of the rationale for deciding the other sources of radioactive material that should be included and which may be excluded in the composite analysis. The following numbers correspond to the numbered areas on the figure. Figure 2 is intended to be a conceptual diagram; it is not to scale. It should not be interpreted as implying the actual unrestricted release of small patches of land surrounded by areas remaining under DOE control.

1. The active or planned Low-Level Waste (LLW) disposal facility is the focus of the composite analysis.

2. A former LLW disposal facility is located adjacent to the active or planned LLW facility. This facility should be considered as a source in the composite analysis. However, based on the predominant groundwater flow direction, the interaction of contaminants from this facility with those from the active or planned LLW disposal facility may be very small.

3. Another old LLW disposal facility is located near the active or planned LLW facility and should be considered as a source. Because this old LLW disposal facility is up-gradient (in the groundwater) from the active or planned LLW disposal facility, it will probably have a significant impact on the composite dose to a hypothetical future member of the public.

4. A former disposal facility for liquid LLW (pond, crib, seepage basin, etc.) is located on the DOE site. Based on its location and the direction of groundwater flow, contaminants from facility #4 will probably interact with those released from facility #1.

5. An old spill (or release of some sort) of radioactive material is located on the DOE site. Based on its location and the direction of groundwater flow, this source will probably not interact with facility #1 and can probably be excluded. The composite analysis should provide justification for excluding the source.

6. A cell for disposing of wastes generated by CERCLA activities is located down-gradient from the LLW disposal facility. Because of its proximity to the LLW disposal facility it should also be considered as a source. In fact, assuming that the wastes to be disposed of in the cell are LLW, a composite analysis must be done to determine the impact of the other facilities (including facility #1) on the performance of the CERCLA cell. Due to the proximity of the two facilities, it would probably be expedient to have one composite analysis serve for both facility #1 and #6 (see Section 3.1.6).

7. A nuclear material processing facility (or any facility that could contain radioactive material such as a nuclear reactor, chemical separations facility, reactor fuel manufacturing facility, research laboratory, etc.) is located on the DOE site. It should

be presumed that the radioactive material will be contained within the facility (building(s)) and will be removed during decommissioning of the facility. Therefore, the facility need not be considered as a source (see Section 3.2.1.5). However, if radioactive material is known to have been released from the facility into the environment, the released radioactive material must be considered as a source. If it is likely that decommissioning of the facility will leave residual radioactive material, the residue must be considered unless the property has been released for public use.

8. Another old LLW disposal facility (or liquid LLW disposal facility, or spill) is located on the DOE site. Because of its distance from facility #1, and the groundwater flow direction, it could probably be excluded from the composite analysis. However, the composite analysis must provide justification for excluding this source.

9. A collection of high-level waste storage tanks is also located on the DOE site. Even though the tanks are relatively far from facility #1, they are downgradient from #1 and would probably contribute to the dose to a hypothetical future member of the public. Therefore, the tanks should be considered as a source in the composite analysis.

The sources identified above (numbers 2, 3, 4, 6, 9, and residues from decommissioning source #7, if expected) should be included in the composite analysis for facility #1.

Figure 2 also illustrates an expected future land use boundary. The composite analysis should determine the total dose from all sources determined to be interacting with facility #1 at points outside of the land use boundary. A probable point of assessment, based on the groundwater flow direction, is also indicated.

Appendix 2 - Options Analysis Outline

Summary and Conclusions

Identify the active or planned LLW disposal facility for which the options analysis is being prepared. Summarize the results of the options analysis.

State the conclusions of the options analysis. If the options analysis indicates the need for action, state the preferred action to be taken, with estimated cost and schedule, with any constraints.

Introduction

Identify the active or planned LLW disposal facility under consideration. Summarize the results of the composite analysis.

Potential Mitigating Actions

Discuss each source that may cause the primary dose limit or the dose constraint to be exceeded. For each source, discuss the features of the source that are most likely to cause the exceedance (the magnitude of the inventory, the proximity to the LLW disposal facility, the proximity to the assumed future point(s) of public access, the uncertainty in the source, etc.).

For each source, present potential (or planned) actions that could be taken to reduce the sources impact. Actions to be considered include refining the analysis and/or obtaining data to reduce conservatism, improving the design of the LLW disposal facility, limiting the receipt of waste to be disposed in the LLW disposal facility or requiring waste form performance for waste to be disposed in the LLW disposal facility, and remediating the other sources (such as in situ stabilization or capping, partial or full removal of the radioactive material, etc.). Optimizing the long-term land use boundary should also be considered. In an extreme case, termination of disposal in the LLW disposal facility may be considered to ensure meeting the primary dose limit.

For each action, present the estimated impact of the action on the dose caused by the source and the impact on the total dose to the hypothetical future member of the public. Also, because a cost-benefit analysis may be a necessary part of the process for selecting a reasonable mitigative action, present an estimate of the cost of each action. Include the basis for the cost estimate and an assessment of the degree of uncertainty in the cost estimate. Also, present an estimate of the timing by which each action could be implemented and the potential constraints. Although remediation decisions for the various sources may be influenced by the composite analysis process, final decisions will be made through the CERCLA process, giving due consideration to DOE requirements, including the results of the composite analysis.

Preferred Action

Identify the preferred action and provide justification for the selection. The justification should be based on the cost/benefit analysis conducted, the level of uncertainty inherent in the composite analysis, the number of CERCLA actions still to be completed on the site, and other factors.

Plan for Implementing the Preferred Action

A description of the implementation of the preferred option, including schedule, should be included. The implementation plan should address inclusion of the composite analysis results in future CERCLA actions, into the Environmental Radiological Protection Plan expected to be required by 10 CFR Part 834, and/or into the future land use planning efforts at the site, as appropriate.

Preferred Action

Identify the preferred action and provide justification for the selection. The justification should be based on the cost/benefit analysis conducted, the level of uncertainty inherent in the composite analysis, the number of CERCLA actions still to be completed on the site, and other factors.

Plan for Implementing the Preferred Action

A description of the implementation of the preferred option, including schedule, should be included. The implementation plan should address inclusion of the composite analysis results in future CERCLA actions, into the Environmental Radiological Protection Plan expected to be required by 10 CFR Part 834, and/or into the future land use planning efforts at the site, as appropriate.

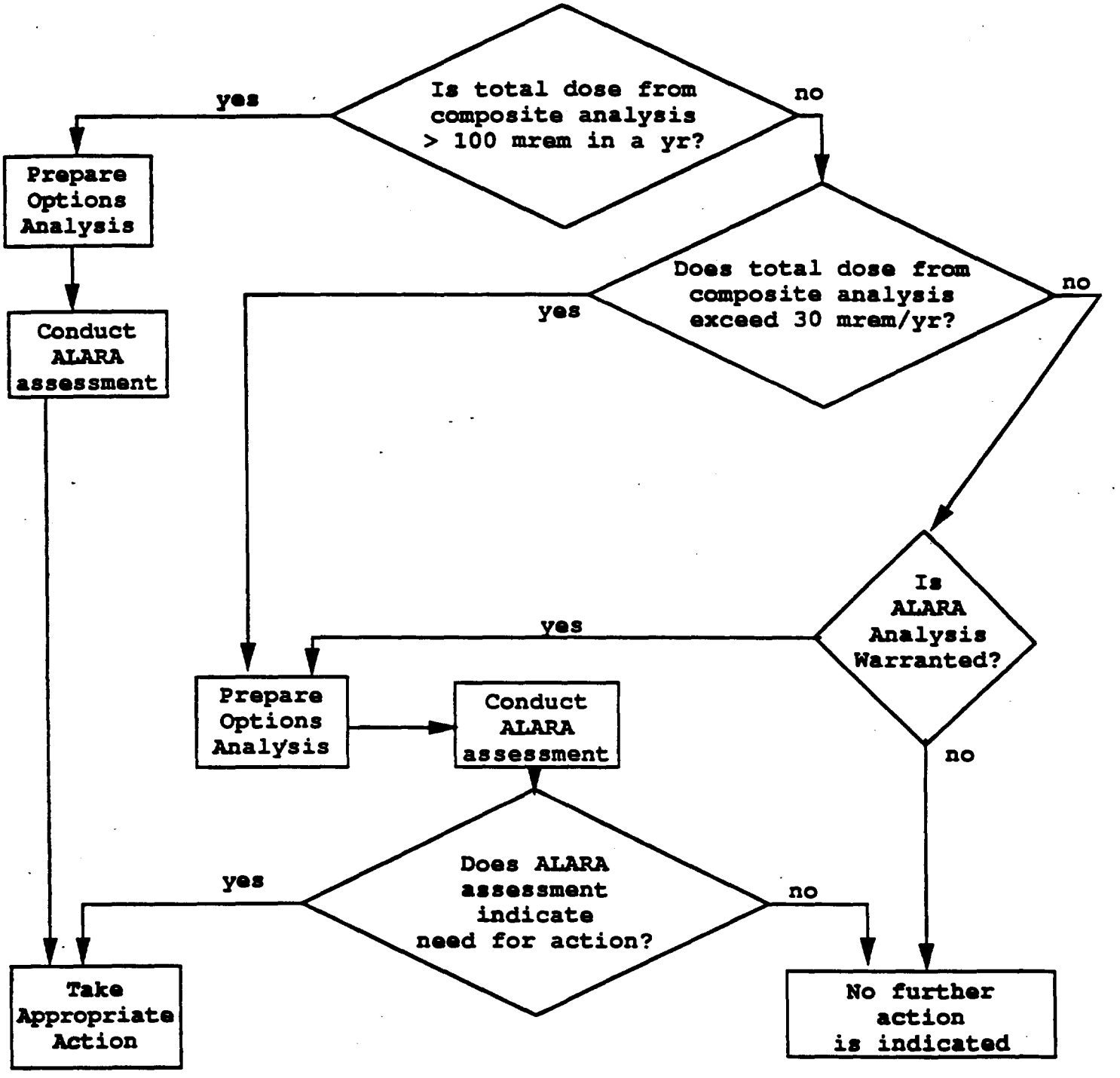

Figure 1: Process for Comparing Composite Analysis Results to Dose Limits

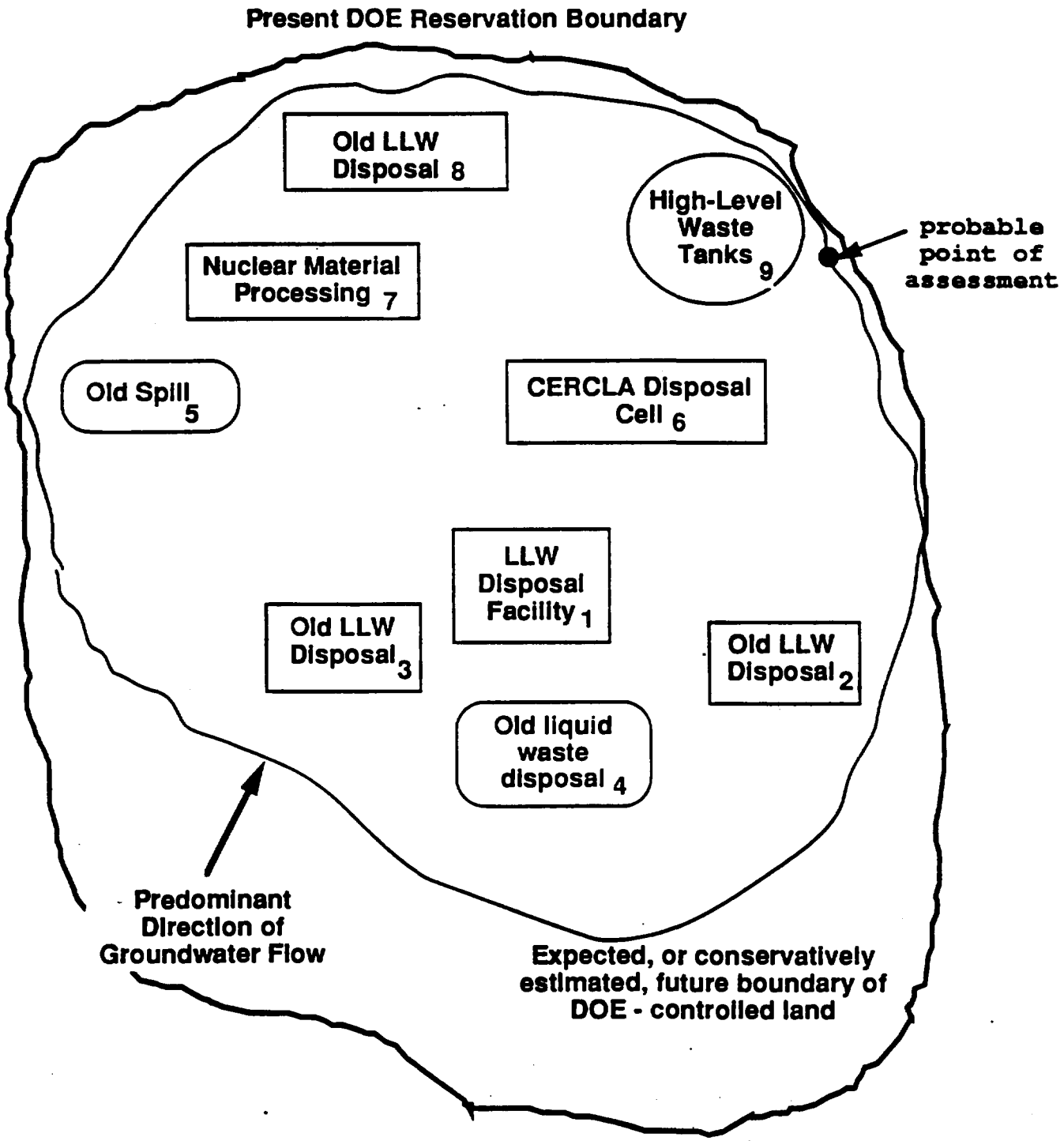

Figure 2: Source Selection Example for the Composite Analysis