Department of Energy
Washington, DC 20585

October 1, 1996

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

Dear Mr. Chairman:

Enclosed is a copy of the *Maintenance of U.S. Department of Energy Low-Level Waste Performance Assessments*. Preparation of this guidance document is a deliverable pursuant to the commitment in Task Initiative VII.B.4.b.1 identified in the Department of Energy's (DOE's) Implementation Plan, Revision 1, for the Defense Nuclear Facilities Safety Board Recommendation 94-2.

The document was developed to provide guidance to field organizations on activities that ensure that disposal facilities are operating in accordance with controls intended to provide a reasonable expectation that the DOE Order 5820.2A radiological performance objectives will be met over the long term. The activities include the conduct of monitoring, testing, and research, as well as performance of routine performance assessment reviews and revisions. This guidance is also being transmitted to those field organizations with responsibility for low-level waste disposal facilities.

The Department has completed the actions for the performance assessment maintenance guide identified under this commitment and proposes closure of the commitment.

Sincerely,

Alvin L. Alm
Assistant Secretary for
Environmental Management

Enclosure

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(8-89)
EFG (07-90)

United States Government | Department of Energy

memorandum

DATE:

REPLY TO ATTN OF: EM-35

SUBJECT: Maintenance Guide for the Department of Energy Low-Level Waste Disposal Facilities

TO: Distribution:

Attached for your use is a copy of the guidance document, ***Maintenance of U.S. Department of Energy Low-Level Waste Performance Assessments.*** This document provides guidance on implementing the requirements for performance assessment maintenance of the Department of Energy (DOE) Order 5820.2A and the maintenance requirements of the July 31, 1996, "Revised Interim Policy on Regulatory Structure for Low-Level Radioactive Waste Management and Disposal," (R.J. Guimond and T.J. O'Toole to Distribution).

This document represents a commitment DOE made in its Implementation Plan for Defense Nuclear Facilities Safety Board Recommendation 94-2. As committed to in the Implementation Plan, DOE is also developing a guidance document addressing the format and content, and DOE review, of low-level waste disposal facility performance assessments. This other document will undergo field and Headquarters review during the first part of October with a planned issuance by the end of October.

If you have questions about the attached document or the format and content/review guidance, please contact Virgil Lowery of my staff on (301) 903-7142.

Mark W. Frei for

Stephen P. Cowan
Deputy Assistant Secretary
for Waste Management
Environmental Management

Attachment

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MAINTENANCE OF U.S. DEPARTMENT OF ENERGY LOW-LEVEL WASTE PERFORMANCE ASSESSMENTS

September 1996

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MAINTENANCE OF U.S. DEPARTMENT OF ENERGY LOW-LEVEL WASTE PERFORMANCE ASSESSMENTS

1. INTRODUCTION

1.1 Background

Order DOE 5820.2A, "Radioactive Waste Management" (U.S. DOE, 1988) requires that "field organizations with disposal sites shall prepare and maintain a site specific radiological performance assessment for the disposal of waste for the purpose of demonstrating compliance with the [radiological] performance objectives." Preparing a site-specific low-level waste (LLW) disposal facility performance assessment (PA) and gaining DOE acceptance or approval are important initial steps in the performance assessment process. Maintenance of the PA following the initial PA analysis is equally important in the process and continues over the operational life of the disposal facility.

Preparation and maintenance of disposal facility PAs represent significant waste disposal facility management activities. The PA provides a means by which the long-term efficacy of the disposal facility is evaluated and provides input to disposal facility design, operational requirements, and waste acceptance criteria. But, because the PA results are based on technically uncertain data, conservative parameters, or both, a PA maintenance program is needed to provide greater confidence in the results of the analysis and in the long-term plans for protecting public health and safety and the environment. Additionally, through the conduct of a PA maintenance program, site operators can technically justify relaxing constraints on waste receipts based on acquiring data allowing a revision of the performance analysis. Acquisition and consideration of field data represents a necessary component of the PA maintenance program. Performance assessment development and refinement represents a continuous process during the operational life of a disposal facility. Initial PAs must be approved by Headquarters. Initial acceptance or approval[1] is based on the PA review and a conclusion that there is sufficient reason to believe, with the information provided, that there is a reasonable expectation that the facility will comply with the LLW performance objectives. Over the lifetime of the disposal facility, the PA must be maintained and upgraded as additional information about the waste, environmental setting, and performance assessment model is obtained. At closure of the disposal facility, a final PA which analyzes all of the waste that has been placed in the disposal facility must be prepared and approved.

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[1] Approval of a PA is conditioned on the completion of a composite analysis. The term "acceptance" is applied to the Headquarters determination that the PA provides a reasonable expectation that the Order DOE 5820.2A performance objectives will be met, pending availability of the composite analysis.

1.2 Policy

Policy regarding the preparation, approval, and maintenance of a LLW disposal facility PA has been issued in the *Revised Interim Policy on Regulatory Structure for Low-Level Radioactive Waste Management and Disposal* (U.S. DOE 1996) (Policy).[2] In accordance with the Policy, sites with active or planned disposal facilities are to prepare a PA and a composite analysis[3]. Following review and acceptance of the PA and composite analysis, Headquarters will issue a disposal authorization statement[4] for the disposal facility. The site is responsible for conducting a PA maintenance program after the initial acceptance of the disposal facility PA.

The Policy defines a PA maintenance program as:

> A program for updating performance assessments based on the acquisition of new information on waste streams or inventories and system component performance. It includes a process for reducing uncertainties in projections about the long-term performance of a disposal facility based on iterations between experimental (e.g., field data acquisition and test facilities to verify waste, engineered barrier, or cover performance, or to confirm critical assumptions made in the performance assessment) and model improvement efforts.

This Policy also makes it clear that maintenance of a PA is an ongoing responsibility of the field organization over the operational life of the disposal facility and requires the Field Office to make an annual determination of the continued adequacy of the PA. In addition, field organizations are to provide a biennial summary of the waste disposal operations with respect to the conclusions and recommendations of the PA. In accordance with the Policy, Headquarters or the field organization may suspend all or a portion of the LLW disposal operations if they determine that an adequate program of PA maintenance is not being implemented.

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[2] This Policy, issued in July 1996, is interim pending its incorporation into a revision of Order DOE 5820.2A. This guidance should continue to be used unless changes are made to the policy at the time it is formalized in the Order.

[3] A composite analysis is an analysis that accounts for all sources of radioactive material that may exist in the ground at a DOE site that may contribute to the dose projected to a hypothetical future member of the public from an active or planned LLW disposal facility.

[4] A disposal authorization statement is a document that sets forth the conditions of design, construction, and operation of a LLW disposal facility to provide a reasonable expectation of compliance with the performance objectives of Order DOE 5820.2A, Chapter III, and considering the results of a composite analysis or other required assessments.

1.3 Purpose

The purpose of this document is to provide guidance for site personnel to use in the development and implementation of a PA[5] maintenance program. In conducting the maintenance of the PA, site personnel should recognize the interrelationship between the PA and the design and operation of a LLW disposal facility. Properly used, the PA is a tool used to direct and evaluate facility design features (e.g., engineered barriers), as well as operational practices (e.g., depth of disposal). In addition, the PA is key to developing waste acceptance criteria and disposal facility radionuclide limits. Recognizing this, the actions carried out as part of the PA maintenance program must be considered with respect to their implications for facility design, facility operations, waste acceptance criteria, and other controlling documents (e.g., procedures).

The purpose of maintaining the PA is to confirm the continued adequacy of the PA, to increase confidence in the results of the PA, and to authorize changes to the controls derived from the PA. This is accomplished through a PA maintenance program that consists of periodic review of the PA, monitoring, and the implementation of tests and research activities. The PA maintenance program includes a process for reducing uncertainties in projections about the long-term performance of a disposal facility based on iterations between experimental and model improvement efforts. Although it is essential that a PA maintenance program be developed for each disposal site, it is appropriate for sites with common data needs to share testing and research responsibilities and results.

This document recognizes three elements of a successful PA maintenance program: (1) reviews and revisions of the PA, (2) monitoring, and (3) test and research activities related to the PA. Low-level waste disposal program managers should consider the utility of documenting the elements of their maintenance program in a plan. Doing so provides a baseline for maintenance activities and can provide a means of documenting the rationale and justification for the activities being conducted. Further, it may be useful in directing the reviews.

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[5] As used in this document, the term PA includes the original document submitted to Headquarters, any supplemental information provided during the course of the review, and any information required to be developed as a condition of acceptance or approval.

2. PERFORMANCE ASSESSMENT REVIEWS AND REVISION

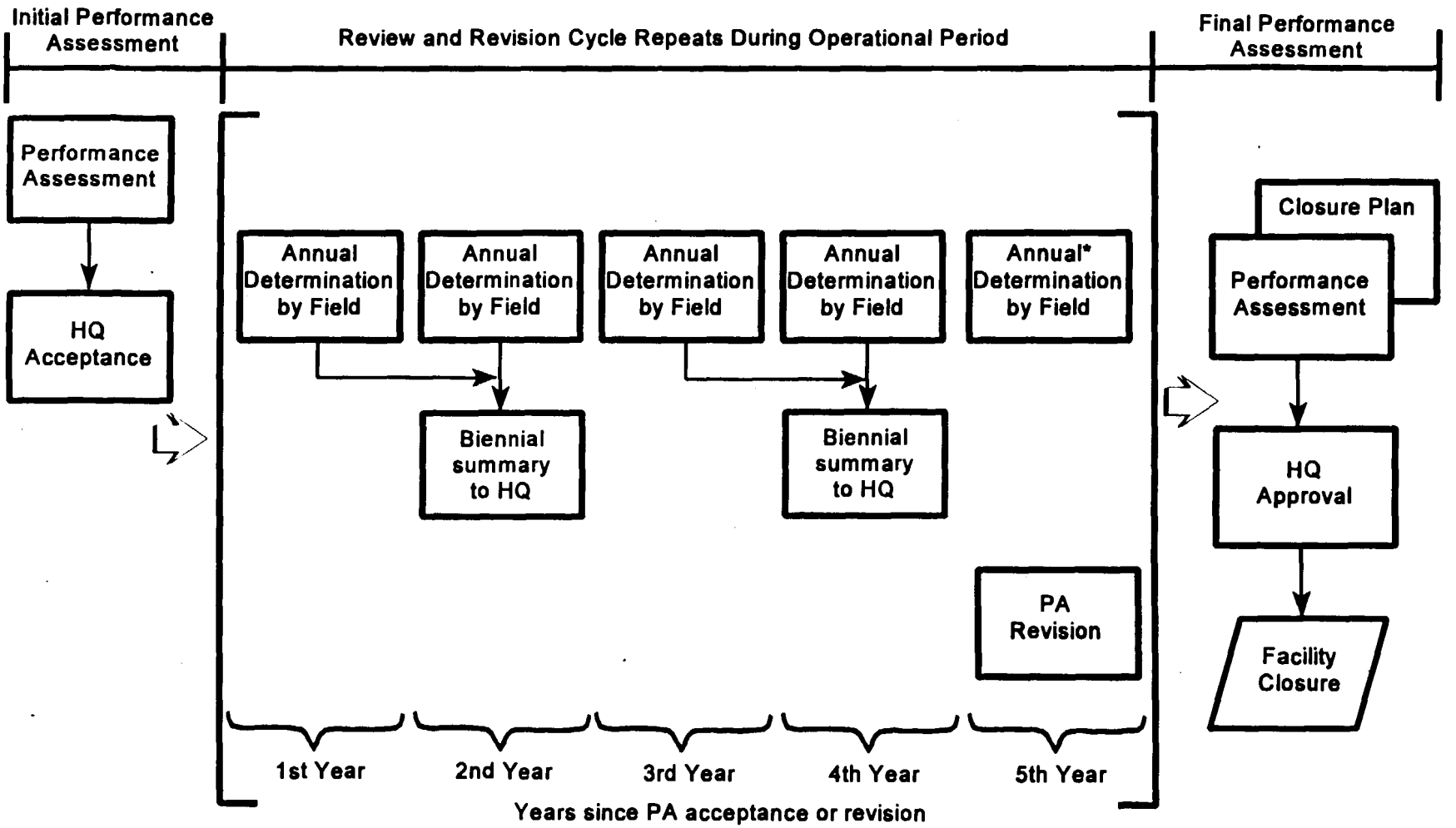
Performance assessment maintenance includes the routine review of the PA and revision of the PA. Reviews provide a mechanism for routine assessment of the PA-derived controls on waste disposal so that potential problems are identified and managed. The PA revisions ensure that there is cohesive documentation providing a reasonable expectation of meeting the Order DOE 5820.2A performance objectives. This use of a PA is similar to the use of a safety analysis report. The assumptions and analyses in the PA are used to establish a performance envelope and are translated into administrative and engineering controls in procedures, waste acceptance criteria, and designs. Reviews are then used to determine whether disposal activities are being conducted or will be conducted in accordance with the controls. Revisions provide a mechanism for evaluating conditions not originally included in the PA analysis to determine if they can be accommodated without violating the conclusions of the PA.

The following sections address annual reviews to be conducted by the Field Office, the biennial summary to be submitted to Headquarters, revision of the PA, and special analyses and reviews. Figure 2.1 provides a graphical presentation of the relationship of the annual review, biennial summary and PA revision. The process of conducting annual reviews, advising Headquarters through biennial summaries, and revising the PA continues throughout the operational life of the disposal facility. At the time when the facility is to be closed, a final PA is prepared, submitted to Headquarters for approval, and, with the closure plan, provides the basis for approving facility closure.

2.1 Annual Determinations

In accordance with the Policy, a Field Office with a disposal facility is to make an annual determination of the continued adequacy of the PA unless directed otherwise. A different frequency than annual may be specified in the disposal authorization statement, or may be requested by Headquarters. The annual determination is to be documented and retrievable.

The annual determination provides the mechanism by which the Field Office ensures that existing controls continue to be effective in ensuring that the PA analysis is valid and to identify potential problems so that they can be managed before they develop into a problem affecting disposal operations. Therefore, the review conducted to support the annual determination must be both retrospective and prospective. The Field Office should review activities that occurred over the last year with respect to their effects on disposal operations and the continued adequacy of the PA in representing facility performance relative to performance objectives. The review should also consider expected future events in terms of their significance to disposal operations and the adequacy of the PA.



* An annual determination may not be necessary depending on the extent of the PA revision.

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Figure 2.1 Routine PA Review and Revision Cycle

The result of the review should be documented in a memorandum that indicates the determination that was made, the basis for the determination, and any specific actions to be taken as a result of the review. The review should include consideration of waste receipts, results of monitoring, testing, and research activities, and other relevant factors.

2.1.1 Waste Receipts

The review of past and future waste receipts is to be based on a review of documentation such as quality records (e.g., receipt records, audits/surveillances), waste projections, and controlling documents (e.g., procedures, waste acceptance criteria). The review should be designed to confirm that the controls on waste receipts are consistent with the limitations derived from the PA analyses. Consequently, reviews should be designed to assess both the radionuclides contained in the waste and the waste form. The reviewer should consider the need to review past waste receipts, revised inventory estimates, projected waste receipts, and total inventory. In most cases, the review would be based on the increment of waste received beyond the known inventory that was included in the most recent revision of the PA. However, if the site has conducted an historical evaluation of waste receipts (e.g., past waste receipts within the time frame analyzed in the PA) that has resulted in a revision to the site's existing inventory, then the review should also include these data. Waste disposed before September 26, 1988 need not be included (unless included in the PA); such waste is to be included in the composite analysis. The waste projected to be received at the site should also be considered to determine whether currently projected waste receipts are nominally the same as those anticipated at the time the PA was prepared. A confirmation should be made that the radionuclide concentrations and total inventories being used to control disposal operations are current.

The review of waste forms should be designed to confirm that the actual disposed waste forms are consistent with waste acceptance criteria derived from the PA. For example, if the PA was based on a critical radionuclide being contained in activated metal with a low release rate, then the review would be designed to determine if the critical radionuclide was actually contained in activated metal and could reasonably be expected to exhibit the low release rate.

The overall result of the review of waste receipts will be a determination of whether any changes are needed to ensure the continued adequacy of the PA with respect to radionuclide limits and waste form requirements.

2.1.2 Monitoring, Tests, and Research Activities

The review should be designed to determine if data collected during monitoring, testing, or research activities indicate that the disposal facility is performing as postulated in the PA, and to determine if the conceptual models are still applicable (i.e., still adequately represent the disposal facility). If testing or research indicates that the facility is functioning within the performance envelope (i.e., results indicate that parameter values are conservative in terms of projected dose), then the information should be noted as confirming the adequacy of the current analysis.

However, if testing or research results indicate that a particular parameter used in the PA may not be as conservative as assumed and the impact would be a significant increase in projected dose, additional analyses may be necessary. Conversely, if testing or research results indicate that a particular parameter used in the PA was overly conservative, these data may provide the basis for special analyses to raise disposal facility radionuclide limits.

Results of monitoring that is specific to the performance of the disposal facility or a component of the disposal facility should be evaluated in the same manner that testing and research results are considered. That is to determine if they indicate the need for any special analyses due to their indication of over- or under-estimating a parameter value. In addition, results from any other relevant monitoring should be considered. The additional monitoring data may be from environmental monitoring in the vicinity of the disposal facility, or some nonroutine monitoring such as liquids collected from the facility.

2.1.3 Other Relevant Factors

The purpose of the annual determination required in the Policy is to routinely assess the adequacy of the PA. As discussed above, a review of past and expected waste receipts, and an evaluation of the results of monitoring, testing, and research programs are important to determining the continuing adequacy of the PA. In addition, there are other operational and design considerations that may be relevant to the determination of PA adequacy. In conducting the annual determination, the following factors may be considered for review. Other factors should also be included if they are relevant to the disposal facility and PA being considered. The review or evaluation will be based principally on available documentation.

<u>Operations</u>

- Disposal geometry:

  - depth of trench,
  - depth of waste profile,
  - thickness of backfill/cover,
  - trench orientation (compared to assumption in PA).

- Waste form and packaging:

  - special waste forms,
  - containers used vs. PA assumptions.

- Waste acceptance criteria:

  - radionuclide limits consistent with PA analyses,

- reporting of PA-significant radionuclides,
- waste form and packaging requirements

- Procedures used to verify waste characteristics (e.g., the radionuclide content).

- Procedures/system to track against total inventory limit.

Facility/Closure Design

- Disposal technology:

  - technologies being used or planned analyzed in the PA;

- Engineered barriers:

  - engineered barriers employed as analyzed in the PA,
  - closure cover design consistent with PA assumption,
  - threats to cover integrity and viability.

- Other design features:

  - provisions for performance monitoring.

- Structural stability:

  - operational controls to enhance stability being employed,
  - unexpected subsidence.

- Future land use:

  - assumptions and analyses in the PA consistent with site future use plans.

2.2 Biennial Summaries

The purpose of the biennial summary is to apprise Headquarters of any significant changes in the site's LLW disposal program and to confirm the continued adequacy of the PA. This is accomplished by summarizing information and the conclusions from the annual determination for the previous year and the current year. The biennial summary shall include the following information:

1. Assessment of PA Adequacy--The biennial report is to provide a summary of the conclusions drawn from the annual determinations made by the Field Office during the prior and

current year. The summary should include a discussion or description of relevant factors, if any, that may have challenged or supported the determination of PA adequacy.

2. Waste Receipts--The Field Office is to include an assessment of waste receipts. The assessment should summarize the information from the annual determinations. The purpose of this section of the biennial summary is to inform Headquarters how the waste received over the past two years compares with what was analyzed in the PA. To effect this, the inventory and concentration of critical nuclides in the waste should be compared to projections or to facility limits. Similarly, the disposal of radionuclides that require special waste forms should be summarized.

3. Monitoring, Test, and Research Results--The results of monitoring that is relevant to the performance of the facility or a component of the facility should be summarized and interpreted. This may include performance monitoring installed specifically to measure a parameter within the disposal system, analysis of water collected in or from the facility, and environmental monitoring in the vicinity of the facility. Environmental monitoring results can be included by reference to another report, but their significance, if any, to the performance of the disposal facility is to be discussed.

4. Summary of Changes--This section is to describe changes to the disposal facility operations or maintenance program that have occurred over the last two years. This would include changes external to the PA that affect the PA analysis such as site land use plans. The Field Office is to describe changes to the disposal facility configuration or operational controls as compared to those described in the PA, including changes that have been made as a result of additional analyses and reviews (see section 2.4). The section is to also discuss the initiation or cessation of monitoring, testing, and research activities over the last two years or any significant changes in the direction of ongoing activities. This discussion should include a rationale for the action taken.

5. Recommended Changes--This section of the biennial summary is to advise Headquarters of planned or contemplated changes in disposal facility design or operations and in the PA maintenance program. The subjects should be the same as covered above in Summary of Changes, but should be forward-looking. Implementation of these recommended changes does not require Headquarters approval.

2.3 Performance Assessment Revisions

Field Offices are required to prepare and submit a revision of the PA to the Deputy Assistant Secretary for Waste Management at least every five years. A shorter revision cycle may be warranted if changes in waste forms or packaging, radionuclide inventories, facility design, closure concepts, or understanding of the facility environment or other features (e.g., engineered

features) alter the conclusions of the PA. It should be noted that significant changes in facility design that alter the basis for the conceptual model will always require a revision of the PA.

A PA revision is to include updated information (e.g., land use plans, results from testing and research), revised analyses, new models, changes in expected radionuclide inventories, or other items affecting calculations of results. The form of the PA revision ranges from a simple amendment to the PA to a reissuance of the PA document. If an amendment to the PA is used, there must be a clear interpretation of how the information in the amendment relates to the original PA analyses and what it means relative to the conclusions reached in the PA. In addition to submitting the PA revision to the Deputy Assistant Secretary, the Field Office 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 PA, the Field Office should consider how cohesive and readily understood the PA is or will be following the revision. For example, if a request for a copy of the PA would yield the original PA document and a large collection of additional documentation, consideration should be given to consolidating the information. If a full revision of the PA document is made, the annual determination (section 2.1) is not necessary.

Upon receipt of a revised PA, 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 PA revision to the initiation of a more thorough and detailed review. Headquarters staff may request additional information from the Field Office as needed to conduct the review.

2.4 Special Analyses and Reviews

Special analyses are expected to be needed as part of the routine maintenance of the PA. As used here, special analyses are analyses performed to evaluate the significance of new information to the results in the PA, or to supplement or amend the analyses performed in the original PA. A number of different factors may prompt a special analysis.

As part of the annual review, the Field Office may identify a concern or potential problem that needs to be evaluated. Resolution of the concern may require the acquisition of data through monitoring, testing, or research or the use of existing data in a special analysis. Additionally, the PA analyst may determine the need for special analyses due to errors found in the prior analyses. Also, ongoing testing and research may yield results that warrant evaluation to determine their significance to the conclusions in the PA.

From an operating program standpoint, 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

LLW disposal site might consider, but the following indicate the types of changes that could necessitate a special analysis in support of operations:

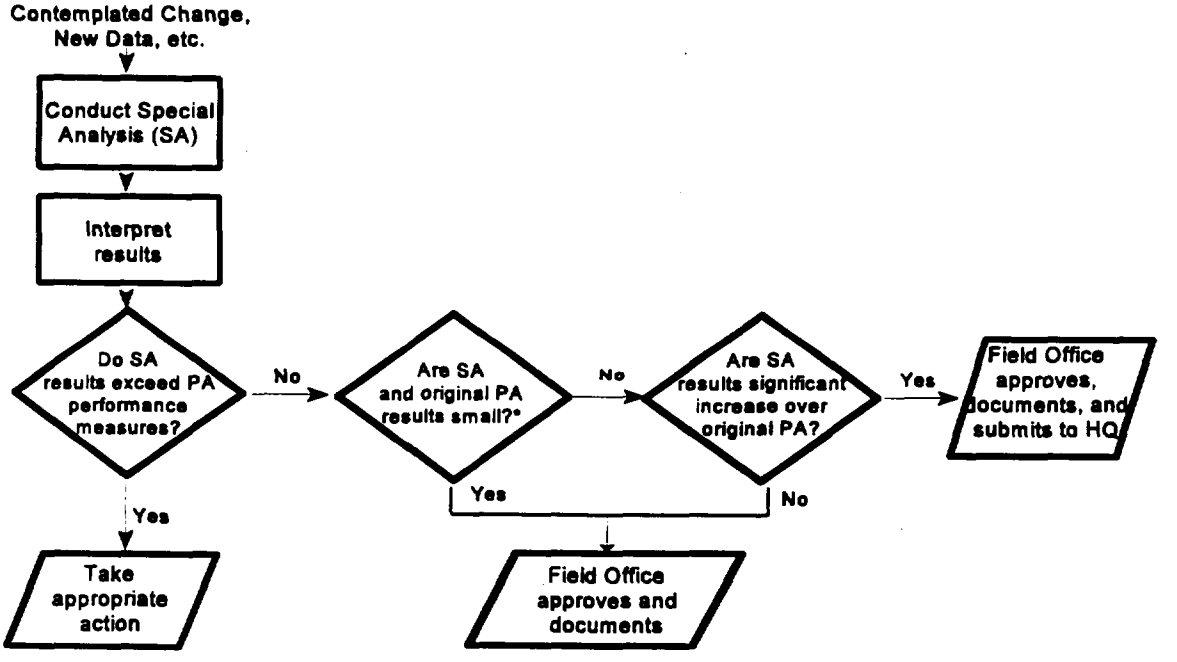
- Disposal of radionuclides not analyzed in the PA;
- Disposal of waste streams not analyzed in the PA;
- Changes in waste forms that could increase release rates for critical radionuclides;
- Waste exceeds the concentrations analyzed for PA-significant radionuclides;
- Waste causes the site to exceed the total inventory analyzed for PA-significant radionuclides; and
- Changes in the disposal facility design or operations from those described in the PA.

The purpose of conducting special analyses can be thought of as similar to the process for resolving Unreviewed Safety Questions (USQ) described in Order DOE 5480.21. The intent of the process is to provide flexibility in day-to-day operations and to require those issues with a significant impact on the PA's conclusions, and therefore the projected compliance with performance objectives, to be brought to the proper level for attention.

The PA is an important element of the authorization basis to operate a DOE disposal facility. The PA identifies those aspects of design and operations that are important to long-term performance and therefore those aspects that DOE relies upon to allow initial and continued operations. Any change that could directly or indirectly affect the facility authorization basis, and therefore its performance, should be analyzed to determine the significance of their affect on the analyzed performance.

Special analyses evaluating proposed changes to the design or operation of the disposal facility or those analyzing new information with the potential to affect the conclusions of the PA should be reviewed and approved by the Field Office. The results of special analyses should be reviewed according to the flow diagram in Figure 2.2. If the special analysis indicates that the performance measures used in the PA would be exceeded, appropriate action must be taken. That action may be as simple as not implementing a proposed change. Depending on the reason for initiating the analysis, the appropriate action may be further analysis, collection of additional data, and/or corrective actions to limit disposal facility operations. Headquarters should be notified unless the action pertains to a change that is considered, but not implemented. A proposed change that does not cause the performance measures to be exceeded must be evaluated to determine whether Headquarters' approval has been dictated elsewhere. For instance, changes in the basic disposal concept (e.g., from vault disposal to shallow land burial) requires review and approval by Headquarters, as would changing specifications in the disposal authorization statement that lead to a significant change in projected dose.

If neither of the above conditions apply, the decision on approval of a special analysis and the actions it implies depends on the significance of the results. A rule-of-thumb is that if the results in the original PA and the results in the special analyses are small relative to the corresponding performance measure, then the Field Office need only document its review and approval. The Field Office should summarize or reference the approval of these special analyses in the annual review documentation and the biennial summary to Headquarters. As used here, about 10% is considered to be small relative to the performance measure. The Field Office should also adopt a similar process for special analyses and related changes that are not small relative to the performance measure if the analysis indicates the change in dose (or concentration depending on the performance measure) is relatively insignificant. Again, as a rule-of-thumb, changes less than a 10% increase in the dose (or concentration) in the original PA are considered insignificant. Special analyses causing changes to the PA results larger than those discussed above are to be submitted to the Deputy Assistant Secretary for Waste Management after review and approval by the Field Office. The submittal should address whether a change to the disposal authorization statement should be implemented or is required by the Policy.



* Less than about 10% of the performance measure.

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Figure 2.2 Special Analysis Flow Diagram

3. MONITORING

Monitoring at a low-level waste (LLW) disposal facility for the purposes of PA maintenance takes place within the larger context of other monitoring activities at the site. An overall site environmental monitoring program will be operating pursuant to the requirements of Order DOE 5400.1 (and 10 CFR 834 when promulgated). There may also be environmental monitoring specifically implemented for the disposal facility. Order DOE 5820.2A, Chapter III.3.b.(3) lists the following requirement relative to performance assessments and monitoring :

> Where practical, monitoring measurements to evaluate actual and prospective performance should be made at locations as required, within and outside each facility and disposal site. Monitoring should also be used to validate or modify models used in performance assessments.

Thus, where practical, performance monitoring of a LLW disposal facility should be included in the PA maintenance program.

The Order also addresses environmental monitoring requirements for low-level waste management facilities in section 3.k. Guidance on environmental monitoring can be found in *Environmental Regulatory Guide for Radiological Monitoring and Environmental Surveillance* (U.S. DOE 1991) and *Environmental Monitoring for Low-Level Waste Disposal Sites* (U.S. DOE 1990).

From a practical standpoint, most environmental monitoring programs will provide little information regarding performance of a disposal facility. This is because, for the most part, disposal facility designs and environmental settings result in very slow releases, if any, over long time periods. Therefore, failure to detect contaminants in an environmental monitoring program indicates only that the facility is not performing dramatically worse than was projected in the PA. Conversely, in the unlikely event of contaminants attributable to the disposal facility being detected well ahead of the time frames indicated from the PA analysis, the PA analysis should be revisited.

The focus on monitoring as part of PA maintenance should be on performance monitoring, that is, monitoring features or processes very close to the waste or facility. As implied by the Order DOE 5820.2A requirement, there are likely going to be practical or technological limitations on the monitoring that can be performed. The LLW disposal program manager will need to consider the PA and work with the analysts and scientists to determine what monitoring should be pursued. This performance monitoring should be driven by the analysis that has been conducted in support of the PA in terms of identifying the parameters to be measured and the locations at which measurements should be made. A process akin to the data quality objectives process may be appropriate for defining the type of data required or desired, the quantity of data needed, the quality of the data needed and the methodologies likely to provide the data.

The effectiveness of the monitoring should be regularly evaluated so that aspects of the program (e.g., sampling locations, technology) can be changed or eliminated if they are not fulfilling their designed purpose.

Performance monitoring can supplement the testing and research activities in strengthening the confidence in models developed to represent performance of the disposal system. It may also be decided that the near-field performance monitoring is appropriate during a portion of the post-closure period to further bolster confidence that the facility is not performing worse than expected.

4. TESTS AND RESEARCH ACTIVITIES

In general, the testing and research activities will have started prior to the preparation of the PA to provide information on which to develop the conceptual models. As part of the PA maintenance program, each site is to continue appropriate testing and research activities. Testing and research to be conducted shall be based on the information generated in the PA. Through the collection of input data, the analysis of performance, and the conduct of sensitivity/uncertainty analyses, the analysts should be able to identify those disposal system components or input parameters that are most important to performance, or most constraining on the resulting radionuclide limits.

In conducting a site-specific PA maintenance program, it is important to recognize that some aspects of the PA are based on simplified conceptual models of the fluid flow and radionuclide transport through engineered facilities and in the surrounding environment. These conceptual models are usually developed using limited site-specific data. Parameter values used in the models are intended to be realistic, but conservative. That is to say when a parameter value is not known accurately, the estimated value is selected to be conservative (i.e., to overestimate doses). Consequences of this situation are that the PA, and the decision that there is a reasonable expectation of meeting performance objectives, are based on some poorly known, but potentially important data, and that the amount and types of waste that a facility can accept may be unduly limited. Therefore, testing and research activities should be designed to confirm or refine the critical assumptions, data, and models used in the PA not only to bolster confidence in the PA results, but also to reduce conservatism.

Another reason for conducting testing and research may be to improve the ability to monitor facility performance. As noted in the previous section, for most radioactive isotopes in a disposal facility, significant migration is not expected to occur for long periods of time. Therefore, it may be desirable to develop the capability to monitor moisture or radionuclide movement very near the waste or to develop surrogates as indicators of waste migration.

To ensure the most effective use of resources, disposal program managers should use a structured process to justify and prioritize the testing and research activities to be pursued. After identifying those components or parameters that are most important to the performance of the facility, the program manager and analyst may apply other criteria to guide the development of the test and research program:

- Which parameters have the largest amount of uncertainty?
- Is a conservatively assumed parameter value affecting the site's ability to accept expected waste streams?
- Are laboratory tests appropriate for determining the parameter?

- Are there other activities or facilities (e.g., existing wells) that can be used to collect needed data?

- Are field tests (large scale barrier tests, lysimeter experiments) most appropriate for providing needed data?

- What testing or research will be most cost effective at reducing uncertainty?

- What time frame is necessary for collecting useful data? For example, some data can be collected over a fairly short time period, so that a delay in initiating the testing or research is acceptable whereas other data will require many years to develop so that initiation of testing must start sooner.

- Can data be acquired at a reasonable cost?

- Is the needed data site-specific or would it be possible to join with others to conduct the testing and research?

- What is most important to stakeholders?

- Are there other significant factors affecting the decision on what testing and research to conduct?

The testing and research portion of PA maintenance needs to be coordinated with the other portions of the program. This includes ensuring that testing and research conform with a quality assurance program. The results of research and testing will form part of the basis for supporting special reviews and for updating the PA. In the longer term, these data will enhance the quality of the PA developed to support closure of the facility and the reasonable expectation of meeting performance objectives.

5. REFERENCES

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