UNREVIEWED DISPOSAL QUESTION: A DISCIPLINED PROCESS TO MANAGE CHANGE IN LLW DISPOSAL OPERATIONS TO ENSURE LONG-TERM PROTECTION OF THE PUBLIC AND THE ENVIRONMENT

J. R. Cook, W. T. Goldston, V. W. Sauls, W. Smith, A. M. Vincent, E. L. Wilhite

ABSTRACT

The Department of Energy's waste management Order, DOE O 435.1, requires that low-level waste disposal facilities develop and maintain a radiological performance assessment to ensure that disposal operations are within a performance envelope defined by performance objectives for long-term protection of the public and the environment. The Order also requires that a radiological composite analysis be developed and maintained to ensure that the disposal facility, in combination with other sources of radioactive material that may remain when all DOE activities have ceased, will not compromise future radiological protection of the public and the environment. The Order further requires that a Disposal Authorization Statement (DAS) be obtained from DOE Headquarters and that the disposal facility be operated within the performance assessment, composite analysis, and DAS.

Maintenance of the performance assessment and composite analysis includes conducting test, research, and monitoring activities to increase confidence in the results of the analyses. It also includes updating the analyses as changes are proposed in the disposal operations or when other information requiring an update becomes available.

Personnel at the Savannah River Site have developed and implemented an innovative process for reviewing proposed or discovered changes in low-level radioactive waste disposal operations. The process is a graded approach to determine, in a disciplined manner, whether changes are within the existing performance envelope, as defined by the performance assessment, composite analysis, and DAS, or whether additional analysis is required to authorize the change. This process is called the Unreviewed Disposal Question (UDQ) process. It has been developed to be analogous to the Unreviewed Safety Question (USQ) process that has been in use within DOE for many years. This is the first formalized system implemented in the DOE-complex to examine low-level waste disposal changes the way the Unreviewed Safety Question process examines changes in nuclear facility operations.

The process, which ensures that proposed or discovered changes receive the appropriate level of review, is now being used whenever changes such as new waste streams or changes in the design of a waste disposal unit are proposed at SRS. The process involves going through a series of questions to ensure that the change is within the existing performance envelope. Two series of questions are used. The first is a simple screening process. If the change is obviously within the performance envelope, it will be screened from further evaluation. If it cannot be screened, technical personnel involved in the performance assessment, composite analysis, and DAS processes, perform a more detailed evaluation using the second set of questions.

If the evaluation shows that the change is within the performance envelope, it can be approved within the contractor's organization. If the evaluation does not clearly conclude that the change is within the performance envelope, then a Special Analysis or other more extensive study is triggered. This is a disciplined way to be sure that one knows which changes are significant and which are not, so that the proper attention can be given to the changes that are significant.

INTRODUCTION

One intent of DOE Order 435.1(1), as expressed in the performance assessment/composite analysis guidance(2), is to ensure that proposed changes in wasteforms, containers, radionuclide inventories, facility design, and operations are reviewed to ensure that the assumptions, results, and conclusions of the DOE approved performance assessment(3) (PA), and composite analysis(4) (CA), as well as any Special Analyses (SA) that might have been performed, remain valid (i.e., that the proposed change is bounded by the PA CA, and SA) and the changes are within the bounds of the Disposal Authorization Statement(5). The goal is to provide flexibility in day-to-day operation and to require those issues with a significant impact on the conclusions of the PA and CA, and therefore the projected compliance with performance objectives/measures, to be identified and brought to the proper level of attention. It should be noted that the term performance measure is used to describe Savannah River Site specific adaptations of the DOE Order 435.1 Performance Objectives and requirements (e.g., performance measures such as applying drinking water standards to the groundwater impacts assessment).

THE PROCESS

The process to analyze proposed changes to the disposal system was based on the Unreviewed Safety Question (USQ) program prescribed by DOE to assess proposed changes to facilities to determine if the change is bounded by the DOE approved Safety Analysis.

The PA for the disposal facility has been incorporated into the Safety Analysis (and thus the DOE Authorization Basis) for the disposal facility. This has resulted in a series of questions/criteria based on key PA parameters being included in the UDQ screening criteria. Using the USQ program results in a graded approach requiring increased levels of analysis and approval authority depending on the magnitude of the proposed change. Figure 1. is a flow diagram of the process that SRS has named the Unreviewed Disposal Question (UDQ) process.

The questions/criteria that are assessed in the USQ screening are shown in Table I. If the USQ screen results in the determination that the proposed disposal activity meets all of the criteria listed, then the proposed activity can be approved.

If any if the items shown in Table I are not true for the proposed change, then the matter falls into the Unreviewed Disposal Question (UDQ) Evaluation process. The UDQ Evaluation is a simple interpretation of existing information to determine if the proposed change is bounded by the performance assessment and composite analysis. The UDQ Evaluation is performed by answering the questions shown in Table II. Some level of technical analysis may be required to demonstrate whether or not the proposed change in the operation will be within the envelope of the performance assessment and composite analysis. However, as a rule of thumb, this analysis should involve only simple mathematical calculations. If the answer to all of the questions is an unequivocal "no," then the result of the Evaluation is that the proposed change is within the performance envelope of the PA, CA, and DAS, and the UDQ Evaluation report becomes the authorizing document for the change. If the answer to any of the questions is "yes," or the question cannot be answered "no" using simple mathematical calculations, then the issue must be resolved either by performing a Special Analysis, altering the proposed change, or deciding to not make the proposed change.

A Special Analysis is a small performance assessment focused on a single issue. It is prepared by the Savannah River Technology Center and is approved by DOE.

THE SRS EXPERIENCE WITH UDQs

As of October 2000, SRS had performed four UDQ Evaluations. The issue addressed by each of these and the results of the evaluations are discussed below.

The first proposed activity addressed by means of a UDQ was disposal of compacted job control waste, non-compactible, non-incinerable waste, and other wasteforms in slit trenches. The effect of trench disposal of low-level wasteforms that were not analyzed in the original performance assessment for the E-Area Low-Level Waste Facility had been analyzed in a revised performance assessment and approved by DOE. However, the results of the revised performance assessment had not been formally implemented into the waste acceptance criteria. This UDQ was conducted to provide a bridge from the current waste acceptance criteria, which are based on the original performance assessment, to waste acceptance criteria that will be developed from the revised performance assessment. The conclusion of the UDQ Evaluation was that any waste, except for materials that would retain radionuclides more strongly than soil (e.g., activated metal), that meets the radionuclide concentration or package limits for trench burial based on the revised performance assessment, and presented in the UDQ, was suitable for trench disposal.

The second UDQ addressed the disposal of a trailer used for transport of spent solvent. The effect of trench disposal of the Spent Solvent Trailer in a manner that was not analyzed in the performance assessment for the E-Area Low-Level Waste Facility was evaluated. The conclusion of the evaluation was that such disposal was bounded by the performance assessment if radionuclide inventory limits derived for such waste in the revised performance assessment are used. This conclusion, taken together with the conclusion of an evaluation of engineered trench disposal leads to the further conclusion that disposal of the Spent Solvent Trailer in the engineered trench is also an acceptable option if the disposal method described in the evaluation is used and the stipulations of the engineered trench evaluation are met.

Figure 2 shows the Spent Solvent Trailer in its storage location. Figure 3 shows the trailer in its disposal location with the grout pour almost to the top of the trailer. Figure 4 shows the final encapsulating pour in progress.

The third UDQ was a "discovery" issue related to the use of an incorrect material as backfill in an intermediate level vault cell. Zero-Bleed Controlled Low Strength Material (CLSM), was mistakenly used in grouting the first layer of waste in the Intermediate Level Non-Tritium Vault (ILNTV) Cell 6 instead of the 2,000-psi grout required by the operating procedure. This evaluation concluded that the CLSM was satisfactory to maintain the PA envelope and may remain in place.

The fourth UDQ was an evaluation of a proposed new LLW disposal activity, disposal of a variety LLW forms in a large engineered trench rather than in slit trenches (at SRS, slit trenches are 20 feet deep by 20 feet wide). The effect of disposing of low-level waste in a much larger trench than the slit trenches was analyzed in the revised performance assessment for the E-Area Low-Level Waste Facility and approved by DOE. However, the results of the revised performance assessment had not been formally implemented into the waste acceptance criteria. Additionally, operations wanted the ability to dispose of a variety of waste forms in one trench. This UDQ was conducted to provide a bridge from the current waste acceptance criteria, which are based on the original performance assessment, to waste acceptance criteria that will be developed from the revised performance assessment. The conclusion of the UDQ was that such disposal is bounded by the performance assessment if restrictions on total radionuclide content and segregation of the waste forms are imposed.

CONCLUSION

The Savannah River Site has developed a disciplined methodology for evaluating changes in low-level radioactive waste disposal operations with respect to the facility's Radiological Performance Assessment, Composite Analysis, and Disposal Authorization Statement. The procedure is analogous to the more traditional Unreviewed Safety Question and has, in fact, been incorporated into that process. Since the UDQ process has been in effect, three proposed changes to the operation and a discovery have been analyzed.

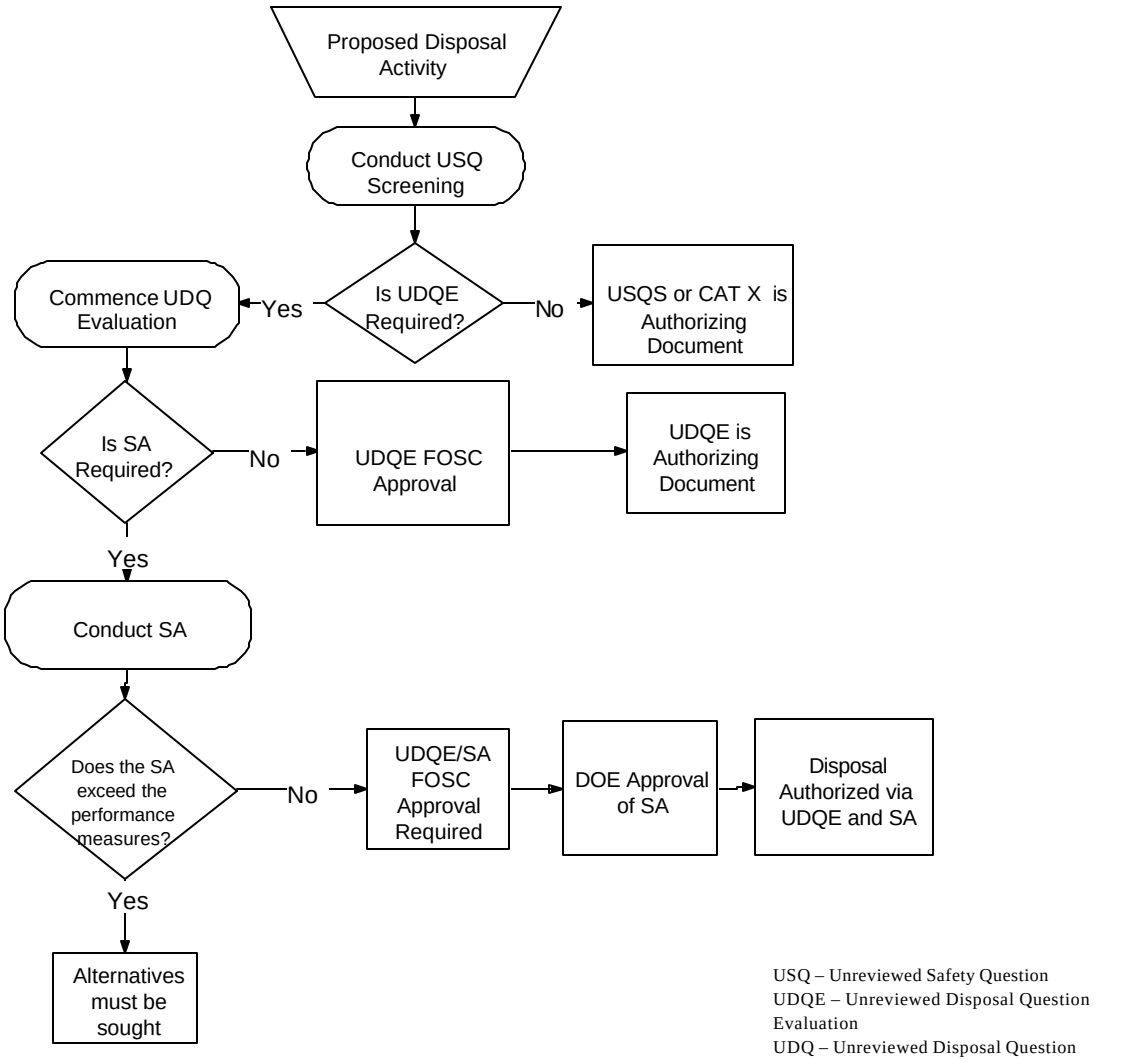

Fig. 1. Flow diagram of the UDQ Process

Table I. Performance Assessment Based Screening Questions

A. If an NR component is being received, the cask shall be bounded by the description in Section 3.3.6 in the PA (the essential criteria for the casks are that they be constructed of carbon steel and have a minimum thickness of 4 cm, (including the thickness of welds). Disposal casks constructed in this manner will not permit ingress of water for 750 years and will support the closure cap for 750 years).

B. If encapsulating a component in grout, there shall be a nominal thickness of 30 cm around the item (including the base/bottom of the item). The thickness is based on that assumed in the PA.

C. The grout being used to encapsulate an item shall be rated at 2000 psi or higher. This strength grout is specified to ensure that it will support the closure cap and has the proper pH. This ensures the Kd values assumed in the PA are protected.

D. The following Waste Acceptance Criteria are being adhered to:
- The volume of liquid waste in a waste package does not exceed 1% by volume. This volume restriction is required to protect assumed release from the waste.
- No organics known to enhance radionuclide solubility/mobility should be disposed of in the waste stream as they affect the Kd values. If in doubt, check.
- No more than 40% of the volume of a trench shall be filled with wood. When wood decays it produces organic material that could affect the Kd values of the surrounding waste.
- The nuclide distribution throughout a waste disposal unit is as analyzed by the PA. The PA assumes the nuclides are equally distributed throughout a given waste disposal unit. Deviations can be approved by the Solid Waste Safety Compliance group without a formal analysis. However, the less homogenous the distribution the greater the potential effect on the PA.
- The backfill used to cover the trenches during the operational phases should have the nominal hydraulic conductivity value used in the PA. These values are shown in the Table on page C-12 of the PA.

D. The bottom of the Trench is placed a nominal 25 feet above the mean water table value. It is recognized that the height of the water table fluctuates, and the PA will be met if the bottom of the trench is 25 feet or greater above the mean value at time of construction.

F. The location of the trenches/vaults is in the same configuration (i.e., location and orientation) as analyzed in the PA (see page 2-5 of the PA). A disposal unit constructed in a configuration other than that as analyzed in the PA could affect the "G" value used in the inadvertent intruder analysis; it could also affect the assumed interaction of groundwater plumes from the different units.

Table II. UDQ Evaluation Questions

1. Does the proposed activity or new information involve a:
   a. change to the Performance Assessment or exceed PA performance measures or alter performance assessment conclusions?
   b. change to the disposal system (i.e., facility design, waste form, closure concept) as described in the PA?
   c. change to the analyses or radionuclide limits as described in the PA?
   d. change in the PA that leads to an increase in the projected impacts (i.e., dose, radon flux, groundwater concentrations)?
   e modification to the analysis or conclusions provided in the Composite Analysis?
   f. change to the Disposal Authorization Statement?

REFERENCES

1. *Radioactive Waste Management*, Order 435.1, U.S. Department of Energy, July 9, 1999.
2. Maintenance Guide for U.S. Department of Energy Low-Level Waste Disposal Facility Performance Assessments and Composite Analyses, U.S. Department of Energy, November 10, 1999.
3. *Radiological Performance Assessment for the E-Area Vaults Disposal Facility*. WSRC-RP-94-218, Rev. 1. Savannah River Laboratory, Westinghouse Savannah River Company, Aiken, SC, January 31, 2000.
4. *Westinghouse Savannah River Company Composite Analysis E-Area Vaults and Saltstone Disposal Facilities*, WSRC-RP-97-311, Rev. 0, September 1997.
5. *Disposal Authorization Statement for the Department of Energy Savannah River Site E-Area Vaults and Saltstone Disposal Facilities*, 9/28/99.
6. WSRC 1S Savannah River Site Waste Acceptance Criteria Manual, Procedure WAC 3.17 Low Level Radioactive Waste Acceptance Criteria, Rev. 2, June 10, 1999.

Fig. 2. Spent Solvent Trailer

Fig. 3. Spent Solvent Trailer Partially Encased in Grout

Fig. 4. Final Grout Pour to Encapsulate Spent Solvent Trailer.