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OVERVIEW OF MILESTONE E ACTIVITIES, "GREATER CONFINEMENT THAN SHALLOW LAND BURIAL"

Lance J. Mezga
Environmental Sciences Division
Oak Ridge National Laboratory*
Oak Ridge, Tennessee 37830

INTRODUCTION

The objective of Milestone E is to "develop the technology and documentation needed to open a site providing greater confinement than shallow land burial" by March 1986. For the purposes of the LLWMP greater confinement has been defined as "the disposal of LLW in such a manner as to provide greater containment of radiation, reduced potential for migration/dispersion of radionuclides, and greater protection from inadvertent human and biological intrusions in order to protect the health and safety of the public" (1). Greater confinement means greater confinement of radionuclides than provided by conventional shallow land burial.

The need for greater confinement than shallow land burial is predicated on the need to isolate certain higher activity or longer-lived radionuclides found in commercial and defense LLW from the biosphere in order to protect the health and safety of the public. These wastes pose a significant health and safety risk if disposed of by conventional shallow land burial as a result of (1) exposure of the waste by erosion, (2) groundwater or vapor transport of radionuclides, (3) intrusions by plants and animals, and (4) inadvertent and intentional human intrusions. The purpose of greater confinement disposal is to reduce these risks to acceptable limits.

NRC's recently proposed regulations on "Licensing Requirements for Land Disposal of Radioactive Waste" 10CFR61 (2), include a waste classification system which explicitly identifies classes of LLW requiring some sort of greater confinement disposal. Class C Intruder Waste requires the use of 5m of cover or the use of engineered barriers to reduce the potential for intrusion. NRC also identifies a category of waste generally not acceptable for near-surface disposal (depths less than 15 to 20m). The NRC waste classification and disposal scheme identifies two broad categories of disposal: (1) near surface disposal including both conventional shallow land burial (i.e., disposal at depths of up to 10m) and greater depth disposal with at least 5m of cover (i.e., disposal at depths of up to 15 to 20m) and/or the use of engineered barriers to reduce intruder potential and (2) non-near surface disposal (i.e., disposal at depths greater than 15 or 20m).

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As defined by the LLWMP, the DOE definition of greater confinement than shallow land burial is purposely broad to provide the agency with the flexibility required in selecting options for achieving greater confinement in the absence of systematic criteria and standards which identify the wastes requiring this type of disposal. DOE has identified burial at greater depths than conventional shallow land burial (i.e., 10m) and the use of engineered barriers, containment, and solidification as options for achieving greater confinement disposal. Once the DOE waste classification system has been completed, the agency will be able to identify which technological option or options are the most appropriate means for achieving greater confinement disposal for specific wastes.

The preliminary program plan developed for completion of Milestone E consists of four basic elements:

- o inventory and preliminary screening of the full range of greater confinement alternatives to shallow land burial,
- o selection of technology option(s) to be further investigated,
- o development of a plan for identifying and implementing R, D&D requirements for the selected technology option(s), and
- o re-evaluation of the selected technology option(s) versus milestone objectives and identification of additional R, D&D requirements.

The program is designed so that these four program elements will be completed within the timeframe of the milestone. Completion of these program elements and issuance of a final report will constitute completion of the milestone.

BACKGROUND

The inventory and evaluation of alternatives providing greater confinement disposal than shallow land burial was an iterative process. Promising technological options were then pursued in more detail. This first round of evaluation or screening was based on such basic issues as:

- o technology readiness,
- o public acceptance, and
- o estimated relative costs.

Both near-term and long-term alternatives were evaluated at the preliminary screening stage. Near-term alternatives considered were (1) greater depth burial, (2) disposal in engineered facilities, (3) disposal in drilled holes, (4) deep well injection, (5) disposal in hydrofractured strata, (6) disposal in cavities, and (7) ocean dumping. Long-term alternatives evaluated were (1) ice sheet disposal, (2) extraterrestrial disposal, (3) subduction zone disposal, and (4) subcrustal disposal. Obviously, all of these options could not be evaluated in the same level of detail because of their state of technical readiness. However, all received at least a preliminary evaluation.

Based on the evaluation criteria, the most promising technological option(s) were selected for further R, D&D funding. While it is true that several of the other alternatives are potentially viable options in the near-term and/or long-term, the limited availability of program funding forced us to focus on the most promising option.

To that end, the option selected for further R, D&D investigations was greater depth burial with or without some combination of solidification, containment, or engineered barriers. Solidification, containment, and engineered barriers were included as options because in some geological/hydrogeological settings, greater depth may not provide greater confinement than SLB, but may actually shorten the pathway to the biosphere by shortening the distance and/or travel time to the groundwater system and ultimately the biosphere.

As indicated previously, the initial program activities focused on identifying and evaluating the full range of alternatives providing greater confinement than SLB. These level one screening activities were performed by:

- Gilbert/Commonwealth: State-of-the-Art Review of Alternatives to Shallow Land Burial of Low-Level Radioactive Waste, ORNL/SUB-79/13837/1, April 1980.
- University of Texas at Austin: Intermediate Depth Burial of Low-Level Radioactive Waste, draft, May 1980.
- University of Arizona, Alternatives to Shallow Land Burial for the Disposal of Low-Level Wastes; Topical Report, Generic Model: Mined Cavities, Vol. 1 through 4, July 1980.
- JRB Associates, Inc.: Assessment of Medium Depth and Deep Disposal of Hazardous Wastes as Related to Low-Level Radioactive Waste Activities, October 7, 1980.
- University of Arizona, Alternativs to Shallow Land Burial for the Disposal of Low-Level Wastes; Topical Report, Generic Model: Engineered Structures, December 1980.

- University of Arizona, Alternatives to Shallow Land Burial for the Disposal of Low-Level Wastes; Topical Report, Time-Tested Underground Structures Suitable for Isolating Low-Level Waste, January 1981.

- University of Arizona, Alternatives to Shallow Land Burial for the Disposal of Low-Level Wastes; Topical Report, Geomechanical Considerations in Siting and Design of Caverns Mined in Limestones of the Midwest, March 1981.

These documents along with the references prepared by NRC and their contractors and other researchers provided the basis for evaluating and selecting the technological options to be advanced to the next level of R, D&D activities.

Once the program determined that the greater confinement disposal task should focus on some combination of greater depth burial, solidification, containment, and engineered barriers, it was further determined that the significant geological and hydrogeological differences between sites located in the arid west and the humid east necessitated the development of parallel programs in these two regimes. The major tasks to be conducted are:

- development of site evaluation and selection criteria,

- identification of waste form effects on leaching rates,

- identification and development of required waste handling equipment, and

- demonstration of the technology to define costs, construction techniques, operational procedures, and monitoring procedures and to document the technical and environmental acceptability of the technology.

Limited funding prohibits the program from completely duplicating these tasks in arid and humid regions. The following activities were funded to accomplish program objectives:

- Ford, Bacon, and Davis Utah, Criteria for Greater Confinement of Radioactive Wastes at Arid Western Sites, prepared for USDOE/Nevada Operations Office, NVO-234, May 1981.

- Ford, Bacon and Davis Utah, Technical Concept for a Test of Greater Confinement Disposal of Radioactive Waste in Unsaturated Media at the Nevada Test Site, draft, June 1981.

- HQ Controlled Milestone LL81.2 "Issue Summary Report Outlining Project Plans, Waste Inventories, and a Monitoring Program for IDB," completed January, 1981.

- HQ Controlled Milestone LL81.11 Technical Position Paper "Evaluation of the Need for Greater Confinement than Shallow Land Burial of Low-Level Wastes," submitted September 1981.

STATUS

As indicated previously, six major information requirements were identified for the program: (1) development of site selection criteria; (2) identification of waste form effects; (3) identification and development of required waste handling equipment; (4) identification of costs, construction techniques, and operational procedures; (5) identification of monitoring requirements and procedures; and (6) demonstration of the technical and environmental acceptability of the technology. In order to resolve these technology-based questions, the LLWMP has funded and/or plans to fund the activities described in the following sections.

Site Selection and Evaluation Criteria

Criteria development (Ford, Bacon, and Davis, Utah)

The purpose of this task was to identify criteria and standards for the design and operation of a greater confinement disposal facility for the disposal of LLW in the arid west. The task also developed methods for evaluating and ranking the importance of factors affecting site selection, design, and performance. This activity was completed and a final report issued in May 1981.

Waste Form

Waste Form Development (Brookhaven National Laboratory)

The objectives of this task are to (1) identify and investigate potential agents and processes for the improved solidification of LLW, (2) define operating parameters for improved solidification of problem wastes, (3) demonstrate the production of full-scale waste forms, and (4) test and evaluate solidified waste forms, and verify compliance with waste form performance and SLB acceptance criteria and transportation requirements. This work item is divided into five subtasks: (1) survey of potential solidification agents, (2) waste stream selection and definition, (3) collection of physical chemical

data on products of the improved solidification of LLW streams and problem wastes, (4) full-scale waste form development, and (5) waste form evaluation. This task was initiated in FY 1981 and will continue into FY 1982. This task attempts to answer many of the questions on waste forms and their behavior.

Waste Handling

Waste Handling Study (Oak Ridge National Laboratory)

The purpose of this task is to assess and evaluate present day practices in the packaging, transport, unloading, and placement into the burial trench of low-level radioactive wastes. A review of the state-of-the-art technology of waste containerization is included in this task. This task was to be initiated in FY 1982, however, the status of funding for this task is uncertain at this time.

Facility Engineering and Construction, Operations, and Monitoring

Greater Confinement Disposal Facility (Department of Energy/Nevada Operations Office)

The purpose of the Greater Confinement Disposal Facility (GCDF) is to demonstrate the economics and technical and environmental acceptability of greater confinement of low-level, higher activity or long-lived, radioactive wastes in order to reduce the potential for biological and inadvertent human intrusions. The GCDF will specifically demonstrate greater confinement in an arid environment by disposal in a drilled hole at the Nevada Test Site. The project consists of six subtasks: (1) technical studies (i.e., systems analyses and evaluations), (2) facility design, (3) facility construction, (4) facility operation, (5) monitoring, and (6) facility decommissioning. Activities on this task were initiated in FY 1981 with construction planned for FY 1982/83 and operation for FY 1983/84. This project will answer many of the technical, economic and environmental questions regarding facility engineering and construction, facility operations, waste handling, and monitoring for a GCDF.

Methods for screening greater confinement disposal sites in humid regions (Savannah River Laboratory)

The purpose of this task is to develop specific methods for selecting greater confinement burial sites in humid regions. Selection criteria will be developed and validated by monitoring a GCF test site to be

built at the Savannah River Plant (SRP) in support of the defense high level waste program. Movement of toxic, nonradioactive waste as well as waste radionuclides will be monitored. Competing factors such as degree of isolation (depth) vs operability of the site will be evaluated. This task consists of four subtasks: (1) operating a small scale demonstration facility using nitrate salts generated as a by-product of solidifying SRP HLW, (2) developing specific methods for selecting sites for greater confinement disposal facilities, (3) developing a reference process for design and operation of a GCF, and (4) monitoring of the proposed GCF. Activities on this task were initiated in FY 1981 and are planned to continue into FY 1982.

Technical support non-shallow land burial (Los Alamos National Laboratory)

The purpose of the task is to provide site screening and evaluation models, evaluate SLB site design activities for applicability to non-SLB sites (i.e., define barriers and water management systems), and develop and evaluate post-closure activities for non-SLB facilities (including completing long-term exposure potential analysis for application to arid non-SLB facilities). This information will be made available to NVO during the design and operations phases of the GCDF. LANL researchers will provide technical support for the design and operation of the GCDF. This task was initiated in FY 1981 and will continue into FY 1982.

These tasks will be discussed in greater detail by the individual investigators later in the program.

The planned milestone chart for completion of this program is presented in Figure 1. This schedule graphically indicates how the various Milestone E activities will fit together. There have been no significant changes in the schedule for completion of Milestone E since last years' meeting and the funded tasks are proceeding on schedule at this time.

REQUIREMENTS TO FULFILL THE MILESTONE

The following sections describe planned future activities necessary to complete the R, D&D requirements of Milestone E.

Site Selection and Evaluation Criteria

Criteria for arid western sites have been developed by Ford, Bacon, & Davis Utah and were issued in FY-1981. SRL is currently developing methods for selecting sites for greater confinement disposal in humid areas and a draft report is due in FY-1982.

Waste Form and Waste Handling

These tasks support Milestone E activities but are actually Milestone G tasks and, therefore, are not discussed here.

Facility Engineering and Construction

The preliminary technical concept plan for the arid GCDF at the NTS was completed in FY 1981 and is currently being finalized. The drilling plan, risk assessment, waste characterization study, and transportation and containerization study will be completed in FY 1982. Engineering and construction activities on the SRL small-scale saltcrete demonstration have been completed. Actual detailed design and construction of the GCDF has yet to begin but is scheduled for late FY 1982.

Facility Operations

The small-scale saltcrete demonstration is currently operating at SRL. The GCDF has yet to become operational.

Monitoring

Preliminary design of the GCDF monitoring system has been completed and is being revised at this time because of changes in budget and technical requirements. Monitoring equipment is to be fabricated and tested during FY 1982. Field emplacement and baseline data acquisition are also scheduled for FY 1982/83.

Final Documentation

ORNL and EG&G Idaho will complete the final documentation necessary to open a site providing greater confinement than Shallow Land Burial in FY 1986 based on the Milestone E funded activities.

SUMMARY

In summary, the objective of Milestone E is to provide the technology and documentation needed to open a site providing greater confinement than shallow land burial. To that end, ORNL has prepared a technical position paper defining greater confinement disposal, options for achieving it, and the need for this disposal technology. In order to meet the objective of the milestones, the LLWMP evaluated the full range of options to shallow land burial and decided to focus on a combination of greater depth solidification containment and engineered barriers. The program identified a series of research needs and then focused program efforts on resolving those needs. These tasks are proceeding on schedule at this time but budget reductions may have an impact on our ability to maintain the schedule.

REFERENCES

1. L. J. Mezga, Technical Position Paper, Evaluation of the Need of Greater Confinement than Shallow Land Burial of Low-Level Wastes, ORNL/NFW 81/29 (October, 1981).

2. Nuclear Regulatory Commission, Proposed Draft Regulations "Licensing Requirements for Land Disposal of Radioactive Wastes," 10CFR61, 46FR38081, Vol. 46, No. 142, July 24, 1981.

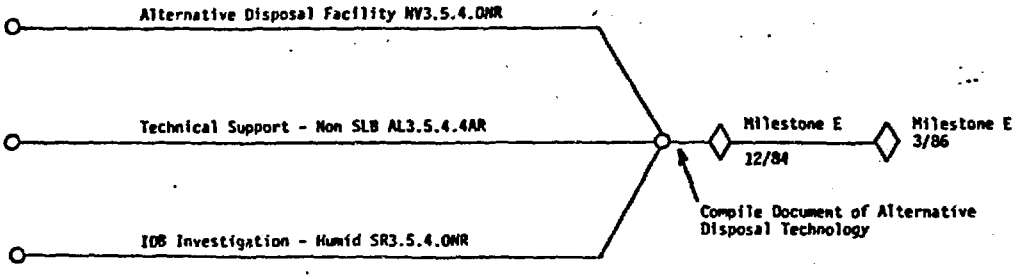

Figure 1. Schedule for Milestone E

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