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To: U.S. Nuclear Regulatory Commission, WMEG

Attn: M.S. Nataraja

From: J. Daemen JD

Re: NRC/DOE Meeting on SCP Performance Allocation, Silver Spring, Md., April 17, 1985.

NRC/DOE Meeting on SCP Repository Design Information, Silver Spring, Md., April 18, 1985.

Date: 5-1-85.

The subject meetings have been attended at the request of NRC, WMEG.

The positions of NRC and of DOE have been presented and clarified. One of the main indirect benefits of the meeting was the attendance of representatives from many DOE contractors. The NRC positions and information needs have been clarified considerably to these contractors, who, to a large extent, produce DOE documents. It would be highly desirable to have DOE contractors exposed to explanations of NRC needs and requirements as frequently as possible.

Significant differences remain between DOE and NRC positions in several important technical areas, e.g.:

- preclosure performance goals.
- assignment of confidence limits and reliability qualifications of performance goals; DOE strongly and consistently opposes qualifications prior to site characterization, for reasons that remain totally unconvincing, although frequently repeated, but never developed in depth.

Considerable confusion and lack of coordination appears to exist between DOE and its main contractors with regard to several major aspects of SCP repository design information needs. Considering the SCP time schedule, this discord must raise serious concerns.

The April 8, 1985 DOE Draft Annotated Outline for the SCP Conceptional Design Report has anumber of deficiencies, many of which have been identified during a preliminary document review. NRC has presented preliminary comments on the draft to DOE, and

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DOE has provided some clarification on its draft. Ensuing discussions revealed the urgent need for DOE contractors to become informed of NRC information needs.

Waste Management '85
J. Daemen

Copy mailed to J. Peshel/D. Gupta, WMEG - might be of interest to them - they are working on this

RETRIEVAL OF SPENT FUEL FROM A REPOSITORY IN TUFF

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ABSTRACT

In accordance with the Nuclear Waste Policy Act (NWPA) OF 1982, federal agencies have developed regulations to ensure that nuclear waste disposal operations will not endanger the public health and safety or the environment. Included in these regulations is the requirement to preserve, as an added measure of assurance, the option to retrieve emplaced spent fuel. Consequently, a repository design must include retrieval as a planned contingency.

The Nevada Nuclear Waste Storage Investigations (NNWSI) project is investigating the feasibility of locating a radioactive waste repository in the tuff formations at Yucca Mountain in southern Nevada. The target horizon is located in the unsaturated zone at an approximate average depth of 300 m below the surface in a formation of welded tuff. Two options are currently being considered for emplacement of waste packages: horizontal and vertical. In the vertical emplacement option, a single package is emplaced in a 7.6-m-deep vertical hole drilled in the floor of the underground rooms. In the horizontal emplacement option, up to 35 canisters are emplaced in a horizontal borehole that is drilled into the side of the underground room. The horizontal boreholes are up to 200 m long. Both options require unique equipment and operations to fulfil the retrievability requirement.

A retrieval plan is being developed to support the repository design for Yucca mountain. This plan will be developed together with the development of conceptual design criteria for surface facilities, underground configurations, and waste-handling equipment.

INTRODUCTION

Background

The U.S. Congress passed the Nuclear Waste Policy Act of 1982 (NWPA) to provide the basic guidelines, schedules, and source of funding for the development of permanent radioactive waste repositories in the United States. The Nevada Nuclear Waste Storage Investigations (NNWSI) project is one of three DOE projects evaluating sites for the location of the first repository. The NNWSI project is investigating the feasibility of constructing a repository at Yucca Mountain, which is located on the Nevada Test Site (NTS), approximately 100 miles northwest of Las Vegas, Nevada. The disposal concept involves emplacing packages of radioactive waste in the tuff formations under Yucca Mountain. The target horizon is a formation of welded tuff located in the unsaturated zone at an approximate average depth of 300 m.

Purpose and Justification

The ability to retrieve emplaced spent fuel is a federally mandated requirement for the design of a repository:

> Section 122 "... any repository constructed on a site approved under this subtitle shall be designed and constructed to permit the retrieval of any spent nuclear fuel placed in such repository..." (NWPA, 1982)

> Section 111(b) "... The geologic repository operations area shall be designed to preserve the option of waste retrieval..." (CFR, 1984)

> Section 14(g) "...Disposal systems shall be selected so that removal of most of the wastes is not precluded..." (EPA, 1982)

Compliance with the retrievability requirement will be demonstrated prior to licensing by the Nuclear Regulatory Commission (NRC). An important aspect of the compliance demonstration process is identifying the major steps which must be performed to safely retrieve emplaced waste. This document outlines the steps to be taken to develop a removal process plan that is specific to an emplacement panel and remove the emplaced waste.

DEVELOPMENT OF A RETRIEVAL PLAN

The development of a retrieval plan must be flexible enough to accommodate changes that occur as information is obtained from maturing design and supporting studies, yet sufficiently structured to ensure that the development is reliable, realistic, and complete. The development must first consider the time frame for retrieval, the site specific concepts for waste emplacement and the expected conditions in the repository during the retrievability period. Then, two approaches to retrieval must be considered:

* Standard Retrieval - Standard procedures are developed for the expected conditions.

* Adverse Retrieval - For retrieval under unlikely adverse conditions, specific corrective actions and removal operations are required.

Retrieval Time Frame

The regulations contained within section 111(b) of 10 CFR 60 (CFR, 1984) establish, for design purposes, the retrieval time frame by requiring that emplaced waste could be retrieved at any time up to 50 years after first waste emplacement (retrieval option period) and establishing the time frame for actual waste removal as the time required for construction of the repository operations area and the emplacement of wastes (retrieval period). The Generic Requirements Document, GRD, (DOE, 1984a) establishes the construction period and the period for emplacement of wastes as 6 years and 28 years, respectively. As shown in Figure 1, for the NNWSI

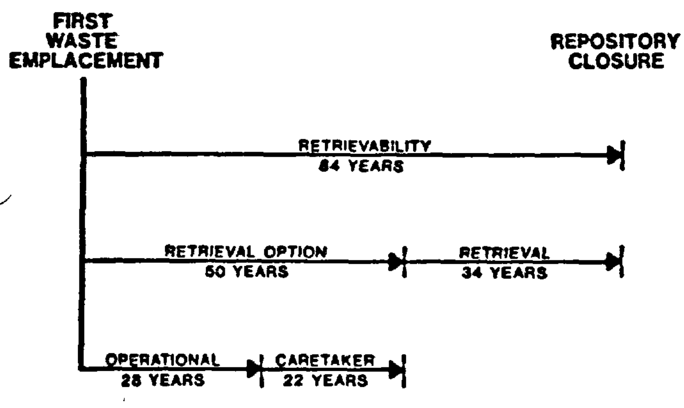

Fig. 1. Retrieval Time Frame

project, the retrieval option period has been proposed as 50 years and the retrieval period has been proposed as 34 years resulting in a retrievability period (maximum period for which retrieval of a specific waste package is possible) of 84 years. From an operational standpoint, the retrieval option period is broken down into the operational and caretaker periods. The operational period is the time period in which the actual emplacement operations are taking place. During the caretaker repository monitoring and periodic drift maintenance will be performed. For design purposes, the operational and caretaker periods are 28 years and 22 years, respectively.

Repository Configuration at Yucca Mountain

Two waste emplacement orientations are under consideration for the NNWSI repository design: vertical and horizontal. The current repository layout for both emplacement options utilizes a ramp for access between the surface and underground facilities. Access drifts are used to gain access to the emplacement drifts where the waste is actually emplaced. The repository is being designed to accommodate spent fuel derived from 59,350 metric tons of uranium (MTU) initially loaded in light water power reactors, 10,000 MTU equivalent of defense high-level waste, and 650 MTU equivalent of West Valley high-level waste for a total equivalent of 70,000 MTU of high-level waste.

The current vertical emplacement concept involves emplacing a single high level waste package into a vertical borehole that is drilled into the floor of the emplacement drift. The emplacement boreholes are 7.6 m deep which results in a stand off distance of 3.0 m. The standoff distance is the shortest distance between the waste package and the emplacement drift.

The current conceptual design for the horizontal emplacement of high level radioactive waste involves the placement of multiple waste packages into blind horizontal boreholes that are drilled into the sides of the emplacement drifts. The boreholes are up to 200 m long and will contain up to 34 waste packages. The current design calls for a 25 m standoff distance.

Expected Conditions

The condition of the drifts and emplacement boreholes at the time of retrieval will greatly affect both the ease of retrieval and the time required for retrieval. The expected conditions within the drifts and emplacement boreholes will be characterized in terms of the following parameters:

* Temperature
* Radiation
* Rock Stability
* Air Quality.

The standoff distance for horizontal emplacement was selected to limit the maximum drift wall temperature to 50 degrees Centigrade for 50 years. With the shorter standoff for the vertical concept, higher temperatures are achieved in a shorter period of time. Preliminary temperature calculations indicate that for the first 100 years, the maximum emplacement drift temperatures for the vertical and horizontal emplacement options would be approximately 110 degrees and 72 degrees Centigrade, respectively (Scully, 1984).

Preliminary studies have been performed to identify areas during the retrieval operation where radiation shielding is of concern (Dennis, 1984). The waste package surface radiation levels for spent fuel (PWR) are estimated to be 17 Krem/hour for gamma and 3.9 rem/hour for neutron radiation (O'Brien, 1984). Using these surface radiation levels and available repository and equipment design information as input, studies are being performed to establish the radiation levels that would be present within the drifts during the a retrieval operation. The permissible dose equivalent is 5 rem/year for worker exposure. The NNWSI design objective is 1 rem/year under normal operating conditions (Dennis, 1984). Consequently, the radiation level in the emplacement rooms and the conditions during retrieval will be such that workers dose rates do not exceed this design objective.

Preliminary studies indicate that the host rock can accommodate the anticipated thermal and mechanical stresses imposed by the excavation of the drifts and the heat produced by the waste (Johnstone, 1984). Additional studies are being performed in support of the design effort to ensure that the drifts will be stable through the the retrievability period. Studies also indicate that the repository can be constructed using standard mining techniques and that standard drift support methods (eg., rockbolts, wire mesh and shotcrete) will be acceptable for drift maintenance (Dravo, 1984)

(Hustrulid, 1984). As a result, it is likely that the drifts will remain stable without excessive deformation or rock fall during the retrievability period of 84 years.

Ventilation studies are currently underway to ensure that the air quality will be maintained within regulatory limits (DOE, 1984b). During the caretaker period, ventilation is not planned for emplacement drifts. Therefore, ventilation will be reestablished prior to initiation of retrieval operations to ensure that nonradiological and radiological air quality standards are met.

As additional information is received from supportive studies and the repository and equipment design process, the expected conditions will be refined and retrieval plans modified accordingly.

Standard Retrieval

For the defined standard retrieval, it is assumed that no adverse conditions exist. This means that no conditions exist that could significantly affect the ability to remove the waste safely using standard retrieval procedures. However, minor maintenance and cleanup may be required. The steps for standard retrieval are presented in Figure 2.

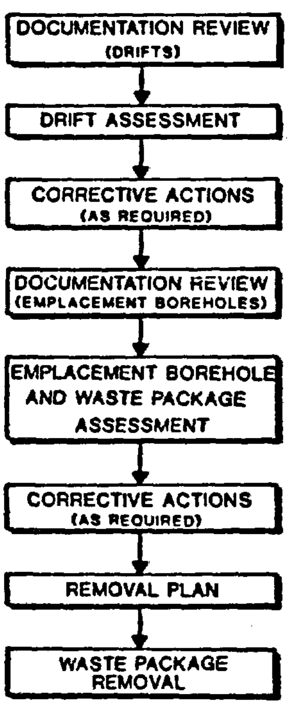

Fig. 2. Standard Retrieval Steps

The first six steps in Figure 2 are performed to ensure that a safe, reliable access exists to the waste package which includes determining the actual condition of the drifts and the emplacement boreholes and performing any required maintenance. A description of those steps follows:

1. Documentation Review (Drifts) - Documentation obtained during drift mining, repository operation, and subsequent monitoring will be reviewed.

2. Drift Assessment - The condition of the drifts (ramp, access drifts, and emplacement drifts) must be determined to ensure safe and functional entry. Various assessment techniques include temperature and radiation monitoring, gas sampling, remote visual inspection and others. If ventilation had been discontinued to the drifts, it would have to be re-established before the drift assessment could be completed.

3. Corrective Actions - Minor corrective actions may be required. Examples of these actions include removal of minor debris from the drift floor, replacement of rockbolts, or other minor repairs. (Note: These are not actions to correct the effects of an adverse condition.)

4. Documentation Review (boreholes and waste package)- Data obtained during borehole drilling, liner emplacement, waste emplacement, and operational monitoring, as well as data on the waste packages within the boreholes, will be reviewed.

5. Borehole Assessment - To determine the condition at an individual borehole, an assessment that includes radiation monitoring and inspection of the collar, collar mount and shield plug will be performed.

6. Corrective Actions - Corrective actions will be performed on those items requiring repair or adjustment (eg., shielding collar repair).

The last two steps in Figure 2 involve developing the removal plan and actually removing the waste. It is assumed that no backfilling is required prior to decommissioning (Fernandez, 1984).

7. Removal Plan - After a safe and functional access path has been established and data from each borehole and drift have been examined, these data, combined with any other relevant input data (eg., surface facility receipt capabilities, etc.), is used to develop a waste removal plan that identifies the sequence of, and time schedule for, the removal of waste packages.

8. Waste Package Removal - The waste package removal process is functionally the reverse of the emplacement process; however, the actual removal process may be more hazardous because of the thermal environment that may exist. Consequently, additional precautions will be taken. The basic ability to retrieve emplaced spent fuel, albeit on a smaller scale and slower rate was demonstrated at the Nevada Test Site during the spent fuel test at the Climax Facility (Ramspott, 1979).

Retrieval Under Adverse Conditions

Retrieval under adverse conditions must be addressed in preparing a retrieval plan. In contrast to standard retrieval, adverse retrieval is required when conditions exist that could significantly affect the ability to remove the waste saf[illegible]ng standard retrieval procedures. The existence of an adverse condition does not mean that retrieval is impossible or particularly hazardous, but it implies that a procedure different from the one used for standard retrieval may be required to perform the retrieval operation.

The retrieval plan must allow for the addition of the consideration of adverse conditions to the standard retrieval steps. The adverse conditions must be identified and evaluated. The flow chart from Figure 2 was modified to include consideration of adverse conditions. The resulting flowchart is presented in Figure 3. The modification of the standard retrieval steps involves the addition of three adverse condition tests to determine whether an adverse condition exists: one after the drift assessment, one after the borehole assessment, and one during waste package removal. In each case, if an adverse condition exists, corrective actions for each condition and removal operations are defined. Then the retrieval process continues.

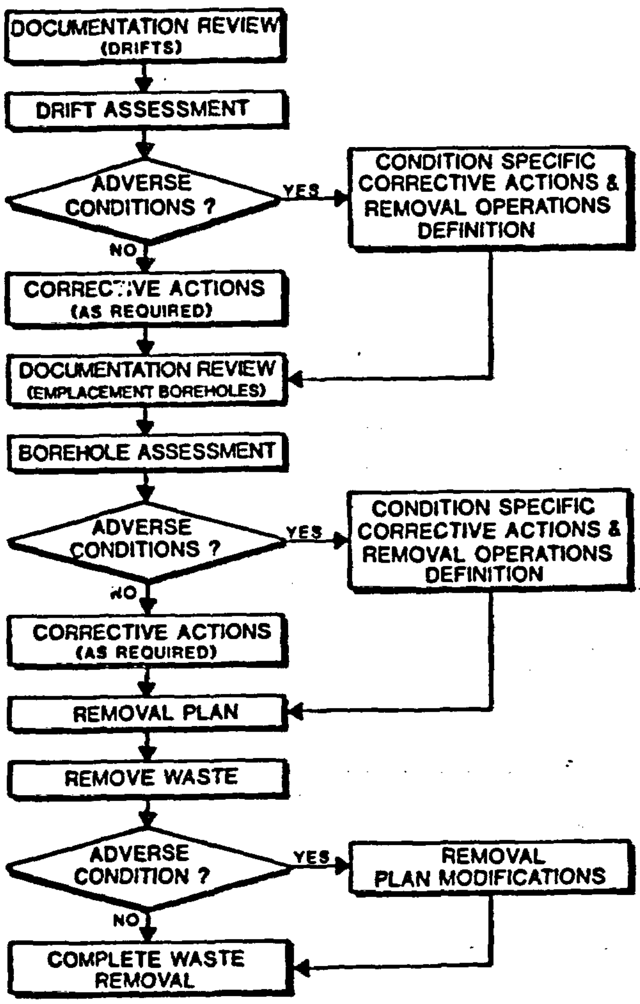

Fig. 3. Retrieval Steps

Potential events or phenomena that could result in an adverse condition or conditions must be identified. To simplify this process, the following grouping of events and processes is used: Natural (eg. earthquakes, floods, etc.), Repository-Induced (eg., drift collapse, excessive temperatures, transporter accident, etc.), and Human-Induced (eg., sabotage, war, etc.). The hum[illegible]ced group is limited to actions performed by persons not associated with the repository. It is recognized that an event could fit into more than one group or category. This is not considered to be a concern since the identified events will be evaluated using the same technique.

After the various potential adverse events and processes have been identified, the resulting adverse conditions will be evaluated. To ensure that the evaluation technique is credible, the evaluation method will investigate the plausibility and the potential impact of the condition, as well as the possibility of design enhancements and procedural controls to negate or minimize the impact of the event or events.

CONCLUSIONS

The NWPA of 1982 and federal regulations require that the option to retrieve emplaced nuclear waste is included in the design and construction of a repository. A retrieval plan is being developed to accommodate both the expected and adverse conditions. As part of this development, the retrieval time frame has been established and repository configurations have been used to quantify the expected repository conditions. The steps for retrieval have been identified, and the framework for identification and evaluation of adverse events has been developed. With the current knowledge of the retrieval time frame, repository concepts, and expected conditions, the identification and evaluation of adverse events is proceeding with a focus on the impact of adverse events on equipment and repository designs and on retrieval operations.

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