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MEMORANDUM FOR: Robert E. Browning, Acting Director
Division of Waste Management

FROM: Michael J. Bell, Chief
High-Level Waste Licensing
Management Branch
Division of Waste Management

Hubert J. Miller, Chief
High-Level Waste Technical
Development Branch
Division of Waste Management

SUBJECT: OPS PLAN COMMITMENT 311338

Attached please find a copy of the document "High-Level Waste Modeling Strategy." This is an outline of a first draft which is to be the basis of the HLW modeling strategy to be completed in June, 1983. This satisfies OPS Plan Commitment 311338, "Review of Model Requirements and Update Modeling Strategy, Draft," due March 31, 1983.

Original Signed By:

Michael J. Bell, Chief
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Enclosure:
As stated

Noted

As discussed w/ PJJ

See previous concurrence

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HIGH-LEVEL WASTE MANAGEMENT MODELING STRATEGY

INTRODUCTION AND SCOPE

During the next several years, the NRC staff will be reviewing and analyzing the data being collected and interpreted by DOE in support of an application for a high-level waste repository in 1987. Models and codes will be utilized by DOE for analyses and interpretation of their data being collected. The NRC staff will also have a critical need to analyze and evaluate the data submitted by DOE. These models and codes will also facilitate the NRC staff's understanding of a site being evaluated for a high-level waste repository and will provide means of interaction between DOE and NRC.

Selection and application of these models and codes should be based on needs that are consistent with the requirements of 10 CFR 60.

A modeling strategy document which is to be finalized by June 30, 1983, will be based on the following outline:

Needs - identification of modeling needs in terms of 10 CFR 60

- how these needs could be met with different types of models and codes

Selection and Scale of Models

Use of Models for - Review and Analysis of Site Characterization Plan

- Identification of data needs
- Development of conceptual model(s)
- Performance assessment
- Criteria for code selection
- Licensing

Application of Models and Codes

In reviewing a DOE application, NRC does not intend to independently duplicate all of the analyses contained or referred to in the application. The NRC staff should develop independent capabilities of analyzing each of the major conclusions reached by DOE.

DEFINITIONS

Computer code. A set of computer instructions for performing the operations specified in a numerical model.

Consequence analysis. A method by which the consequences of an event are calculated and expressed in some quantitative way, e.g., money loss, or quantities of radionuclides released to the accessible environment.

Controlled area. A surface location, to be marked by suitable monuments extending horizontally no more than 10 km in any direction from the underground facility, and the underlying subsurface, which area has been committed to use as a geologic repository and from which incompatible activities would be restricted following permanent closure (§60.2).

Finding. A determination of compliance or noncompliance with a specific requirement. A finding which addresses a numerical performance objective will be reached after the following are considered: the results of a reliability analysis and the laboratory and field tests upon which it is based, expert opinion, and empirical studies.

Licensing assessment. An assessment of whether a license application complies with all of the requirements that it purports to meet. For this program it is the sum of the individual findings for each of the requirements of 10 CFR 60.

Mathematical model. A mathematical representation of a process, component, or system.

Model. A representation of a process, component, or system.

Numerical method. A procedure for solving a problem primarily by a sequence of arithmetic operations.

Numerical model. A representation of a process, component, or system using numerical methods.

Performance assessment. The process of quantitatively evaluating component and system behavior, relative to containment and isolation of radioactive wastes, to support development of a high-level waste repository and to determine compliance with the numerical criteria associated with the regulation (10 CFR 60).

Performance confirmation. The program of tests, experiments, and analyses that is conducted to evaluate the accuracy and adequacy of the information used to determine reasonable assurance that the performance objectives for the period after permanent closure can be met.

Quality assurance. Those planned and systematic actions necessary to provide adequate confidence that a structure, system, or component will perform satisfactorily in service, or that a product such as a mathematical analysis or a data measurement will be sufficiently free from error to serve its intended purpose.

Reliability. The probability that a system or component, when operating under stated environmental conditions, will perform its intended function adequately for a specified interval of time.

Reliability analysis. An analysis that estimates the reliability of a system or component.

Risk. A measure of the probability and severity of adverse effects (consequences); the expected detriment per unit time to a person or a population from a given cause.

Risk analysis. An analysis that combines estimates of the probabilities of scenarios with estimates of the consequences of those scenarios, while considering the uncertainties associated with both.

Scenario. An account or sequence of a projected course of action or events.

Scenario analysis. The process of identifying scenarios and estimating the probability of their occurrence.

Sensitivity analysis. An analysis in which one or more parameters are varied to observe their effects on the performance of a system or some part of it. Such an analysis requires definition of a system, the ranges of parameters over which the system is to be investigated, and the characteristics of the system which is to be observed.

Uncertainty analysis. An analysis that estimates the uncertainty in a system's performance resulting from the uncertainty of one or more factors associated with the system. Such an analysis requires definition of a system, description of the uncertainties in the factors that are to be investigated, and the characteristics of the system that is to be observed.

Underground facility. The underground structure, including openings and backfill materials, but excluding shafts, boreholes, and their seals.

Validation. Assurance that a model as embodied in a computer code is a correct representation of the process or system for which it is intended.

Verification. Assurance that a computer code correctly performs the operations specified in a numerical model.

DEVELOPMENT OF MODELING STRATEGY

This strategy encompasses those numerical modeling activities needed to discharge NRC responsiblities from now through processing a license application, including reviewing Site Characterization Plans, providing guidance to DOE, preparing to process a license application, and, finally, processing the application. The culmination of these activities is reaching findings on the compliance of the application with the requirements of 10 CFR Part 60. The questions which must be addressed to proceed from 10 CFR Part 60 to the specific actions called for by this strategy are:

1) What are the specific findings to be reached?

2) What specific actions does the NRC staff expect to take to reach those findings?

3) What capabilities must the NRC staff and its contractors have to take those actions?

4) Which of those capabilities remain to be developed at this time?

5) How shall the NRC go about developing them?

6) What information must DOE provide for the NRC staff to be able to reach the finding?

7) What guidance shall NRC provide to DOE prior to licensing to ensure that DOE provides the necessary information?

SPECIFIC FINDINGS

Specific criteria on which findings will be made within 10 CFR Part 60 which can only be reached with the aid of numerical modeling were identified in the NRC BWIP SCA as follows:

(1) <u>Through permanent closure</u>

§60.111(a), limiting radiation exposures and releases of radioactive material during operations.

§60.111(b), requiring that the option of waste retrieval be preserved during operations.

(2) <u>After permanent closure</u>

§60.112, limiting releases of radioactive materials to the accessible environment after permanent closure to those permitted by the EPA standard (proposed 40 CFR 191).

§60.113(a)(1)(ii)(A), requiring a minimum waste package containment time.

§60.113(a)(1)(ii)(B), limiting the radionuclide release rate from the engineered barrier system.

§60.113(a)(2), addressing minimum pre-emplacement groundwater travel time from the disturbed zone to the accessible environment.

In addition to the above numerical performance objectives, numerical modeling contributes to many of the other assessments that 10 CFR 60 requires. For example, the purpose of assessing favorable and potential adverse geologic conditions (§60.122) is to determine whether they support or interfere with the ability of the geologic repository to comply with the performance objectives; numerical modeling is an essential step in determining the relationship between the performance objectives and the favorable and potentially adverse conditions.

NRC STAFF ACTIONS REQUIRED TO REACH FINDINGS

It is expected that numerical models will <u>support</u> findings. That is, the findings will be reached by a <u>Licensing Assessment</u> which includes

Numerical techniques (including models and codes)

Laboratory and field tests

Expert judgment

Empirical approaches

With respect to all of the above criteria, NRC must be able to independently manipulate the data to the extent necessary to assess the performance of the repository. This ability includes the capability of exercising appropriate computer codes.

It is expected that during licensing the NRC staff and contractors will exercise a number of codes to investigate several scenarios, taking into account the uncertainties in the site data. This computing exercise may well be too large for the staff to perform without contractor assistance, but it is necessary that the staff will be capable of using the codes and understanding the results.

In reviewing a DOE application, NRC does not intend to independently duplicate all of the DOE calculations contained or referred to in the application. Such duplication would require extensive resources and would greatly lengthen the time needed for the staff to review the application. A sound technical review can be performed without complete duplication by thoroughly checking selected portions of the technical work; by performing an independent technical review of critical data and analysis of uncertainties; and by factoring in diverse technical opinions.

The NRC staff will review each of the major conclusions reached by DOE on the basis of computer calculations in the following way. First, NRC will perform a check on the conclusions using simple numerical models and bounding assumptions. If no problems are uncovered, NRC will then exercise NRC approved codes for one or more of the DOE data sets to determine whether results similar to those claimed by DOE can be reached. At this time NRC will also review the code used by DOE to assess the liklihood that the code has properly performed those runs not independently checked by an NRC approved code.

It is expected that this review will require 5 to 20% of the staff and computer resources used by DOE in preparing the application. However, acquiring the capability of performing the review is expected to require resources for code development and benchmarking comparable to those needed by DOE.

Actions required to develop the performance evaluation parts of the licensing assessment activities are listed in Attachement No. 1. Areas of responsibility for these actions will be defined in the final document. Some of these actions will be completed jointly by the technical staff from WMHL and WMHT.

ATTACHMENT 1

ACTIONS REQUIRED TO DEVELOP THE PERFORMANCE EVALUATION
PARTS OF THE LICENSING ASSESSMENT ACTIVITIES

SELECT NUMERICAL MODELS AND CODES

- Identify needs

    a) Prelicensing activities
    b) Licensing activities
    c) Develop conceptual models
    d) Select scenarios

- Identify models and codes available

    a) Prelicensing activities
    b) Licensing activities

- Select models and codes for modification and application

    a) Prelicensing activities
    b) Licensing activities

EVALUATE SELECTED NUMERICAL MODELS AND CODES

- Verify the codes
- Benchmark the codes

APPLY THE NUMERICAL MODELS AND CODES

a) Prelicensing activities

   - Specify appropriate data and associated uncertainties for the numerical models
   - Incorporate available data and uncertainties into the numerical models
   - Calibrate the numerical models to the extent practicable
   - Perform sensitivity analyses
   - Use results of sensitivity analyses to identify data needed for licensing to support site characterization and the development of the engineered barrier system; and to modify numerical models and codes as needed

b) Licensing activities

- Finalize the set of scenarios

  Determine the probability of the senarios

  based on expert opinion

  based on numerical modeling

- Formulate models of reasonable scenarios

  Conceptual models

  Numerical models and computer codes

- Evaluate the data required by the models, including associated uncertainties

- Incorporate the data and uncertainties into the models

- Refine and recalibrate the models as needed

- Perform a reliability analysis of the senarios

- Interpret the results of the reliability analysis on the basis of physical intuition

- Make findings on the performance objectives based on the results of the model exercises