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SEP 8 1983

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

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

WM Record File 109.2
WM Project 1
Docket No.
PDR ✓
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SUBJECT: MODELING STRATEGY DEVELOPMENT

To complete the updated Modeling Strategy Document, I am requesting assistance from your branch. The document will establish NRC's modeling strategy and required modeling capabilities to review applications for licenses for constructing and operating HLW repositories.

The attached revised guidelines for the strategy development should foster a more consistent, technically-complete strategy than the version of the strategy that was completed in June. Please find also attached a listing of the findings to be made during licensing review based on 10 CFR Part 60 that will require numerical and analytical modeling capabilities of the NRC. Each of the findings and the qualitative siting evaluations will be addressed in a separate chapter.

I anticipate that three staff days will be required to develop the strategy for each of the chapters that identify the required modeling capabilities of the NRC for the findings (items 1-9) and 1.5 days will be required to address the necessary NRC capabilities required to review siting criteria evaluations. The WMHT staff members, who are identified as the appropriate authors for these chapters, are also listed with the findings to be addressed. Please have your staff

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OFC	WMHL	WMHL	WMHL RB for			
NAME	*MFWeber	DJFehringer	MJBell			
DATE	9/ /83	9/ /83	9/ 8 /83			

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members return completed drafts of their individual chapters by COB, Friday, September 23, 1983 to Michael Weber of my staff.

Thank you for your cooperation.

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

*See Previous Concurrence

OFC	WMHL	WMHL	WMHL			
NAME	*MFWeber	*DJFehringer	MJBell			
DATE	9/ /83	9/ /83	9/ /83			

REVISED GUIDELINES FOR MODELING STRATEGY DEVELOPMENT
AUGUST 22, 1983

These guidelines present a concise framework for the development of a modeling strategy for HLW. Individual authors should modify the guidelines to adequately address their assigned topics for discussion. This adaptation, however, should not delete any of the pertinent sections, which are detailed in section II. Section I provides the reader with background information and underlying principles that should be considered in the preparation of the modeling strategy. Section II consists of the detailed process for the development of the strategy.

I. PRINCIPLES FOR STRATEGY DEVELOPMENT

Purpose: to drive the development, evaluation, and application of quantitative (analytical and numerical) models and computer codes by NRC staff and contractors to ensure a technically sound, coordinated program that, with appropriate modifications as needed, will serve NRC through the time of licensing.

Scope: the strategy encompasses quantitative modeling and computer activities necessary to discharge NRC responsibilities until the review of a license application for decommissioning of a HLW repository. This includes:

- establishing licensing information needs,
- reviewing Site Characterization Plans (SCP's) and preparing additional pre-licensing guidance to DOE,
- preparing to review the license applications, and
- reviewing the applications.

Expected Content of the License Applications

To simplify the development of the modeling strategy, certain assumptions need to be made or else the modeling strategy would be unfocused and unwieldy. The modeling strategy will presume that portions of the license application, which are supported by numerical and analytical modeling, will be well-documented and consistent with all other sections of the license application. The following general assumptions about the license application address all topical sections of the modeling strategy:

° DOE will use a limited number of codes.

° When two or more codes are used to calculate or compute the same type of results, these results will be very similar and within the numerical accuracy of the techniques in practice.

° DOE will assert that these codes address all of the features and/or processes which significantly affect repository performance or any portion contributing to overall repository performance.

° DOE will adequately benchmark and verify the codes to be used in support of a license application and demonstrate that the codes compare well with similar type codes and analytical solutions.

° DOE will use the codes to demonstrate that repository performance clearly complies with the performance relevant criterion.

° NRC will have substantial advance notice of the codes that will be used to demonstrate compliance, and these codes will reflect NRC guidance to DOE as to how processes, parameters, and variables will be treated.

As a tangible example of what these assumptions specify, NRC expects that the license applications will use fewer codes than listed in Chapter 12 of the BWIP SCR to address the performance criteria; that these codes will be substantially better documented, benchmarked, verified, and validated; and that the data incorporated when applying the codes to particular models will be internally consistent with values for the same parameters in other sections of the SCR (e.g., geochemistry, hydrogeology, etc.).

Alternative Levels of NRC Effort

The level of effort required of NRC staff and contractors prior to and during repository licensing spans the spectrum from merely posing technical questions to developing in-house capabilities that are equivalent to or exceed those of DOE. The most appropriate level of effort is most probably within these extrema. The minimal action that NRC must take to prepare and review the application's content is to continue to review documentation provided by DOE and pose sound technical questions to DOE until the responses from DOE provide reasonable assurance that the performance of the repository will comply with 10 CFR Part 60 and 40 CFR Part 191. While the ability to ask such questions will not require developing and applying computer codes, the NRC staff will have to understand all significant phenomena quantitatively so that the mathematical models underlying the computer codes can be reviewed for their accuracy and validity. This approach to modeling would almost certainly require many technical interchanges (e.g., workshops and technical positions) and could cause unnecessary delays in the licensing process.

At the opposite end of the spectrum of alternative levels of effort, NRC could develop extensive modeling capabilities and attempt to independently reproduce the DOE modeling results. NRC staff and contractors could independently benchmark, verify, and validate the DOE computer codes to evaluate their validity and accuracy. To pursue this approach would require technology, skilled staff, and review time on the same level of effort as that expended by DOE in preparation for licensing.

One of the purposes of this modeling strategy will be to determine the appropriate level of effort that the NRC should expend to develop in-house modeling capabilities, which will be sufficient to fully review the DOE license applications for a HLW repository. It is to the best advantage of the NRC to develop a comprehensive modeling strategy for HLW disposal that does not over-emphasize one particular discipline over the others. Such a strategy might establish NRC policy as to which issues should be prioritized in the review of the license applications. The final strategy will be developed to the same level of technical detail for all findings that the NRC is required to make under 10 CFR Part 60.

II. STEPS TO BE TAKEN IN MODELING STRATEGY DEVELOPMENT

To facilitate the development of the modeling strategy that does not unnecessarily over-emphasize one finding over the other findings, the following sequence of steps should be taken:

1) Identify the specific finding that is being addressed with reference to 10 CFR Part 60.

2) Identify the full range of alternative approaches to addressing the issue. The range should span from assessments that draw heavily from expert judgment to those that will require complex coupled numerical and stochastic models. If modeling will be required, identify the major types of models (e.g., hydrogeologic, geochemical, thermomechanical, etc.) and how these models will be coupled.

3) Identify the assumptions about the content of the DOE license application in its assessment in support of a particular finding. Section I provides a list of general assumptions about the application.

4) Describe the specific actions (i.e., level of effort) that will be required of NRC to arrive at and support that finding. These actions should be consistent with alternative approaches identified in (2) and based on the assumptions in (3).

The discussion of the actions should begin with a statement of the minimal level of effort required of the NRC. Using this discussion as a base, the strategy should then demonstrate why increased modeling activity is necessary to discharge NRC responsibilities through licensing. This discussion should evaluate whether the models will be ahead of data needed to apply the codes and whether specific limitations and flaws have been clearly identified in more simple approaches. The discussion should also indicate that more complex approaches will produce useful results.

5) Identify the capabilities of NRC staff and contractors that are required to execute the specific actions above.

There should be at least one NRC staff member who is sufficiently fluent with each computer code that is used by contractors, so that the staff member can testify that he understands what the contractor has done and that the code has been properly applied. It will be assumed that the same staff member could have done the work himself had time and resources permitted.

6) Compare the required capabilities with the present capabilities of the NRC staff and contractors and those currently under development; Identify deficiencies in NRC's current and projected modeling capabilities by doing the following:

A) Review modeling capabilities now available or under development, and either certify that they are indeed required or demonstrate that they will not be necessary for NRC's review of license applications.

B) Identify capabilities needed but not addressed in the current RES and TA programs, and propose a feasible strategy for acquiring and/or developing the necessary capabilities. This strategy should carry through maintenance and application subsequent to capability development.

Throughout the modeling strategy development, priorities for capability development should be firmly established and supported. Capabilities that are useful should be distinguished from those that are absolutely essential to protect the public health and safety. Whenever complex modeling is essential, the unique and distinguishing characteristics of the models should be clearly identified. With regard to identifying these characteristics for each individual finding, the strategy should address the following questions:

Will generic models suffice to establish system performance, or will site-specific models be required?

Are non-quantitative assessments more appropriate than complex, numerical models, or will simple, conservative assessments suffice to quantitatively evaluate repository performance?

What scale of modeling will be required? For the purposes of the strategy development, the following distances should be associated with modeling scales:

very-near field- cm to m from the waste canisters,
near-field - 10's of m to 10 km from the edge of the underground facility, and
far-field - >10 km from the edge of the underground facility

*FINDINGS TO BE ADDRESSED IN THE MODELING STRATEGY - SEPTEMBER VERSION

1. Retrievability (60.111(b))- T.Seamens
2. Limits on cumulative release of Rh to the accessible environment for the first 10,000 years (60.112) - M. Gordon with D. Fehringer, M. Logsdon, and J. Starmer
3. Waste Package Longevity (60.113(a)1(A)) - M. Knapp
4. Release Rate of the Engineered Barrier System (60.113(a)1(B)) - L. Pittiglio
5. Pre-emplacement Groundwater Travel Time (60.113(a)2) - M. Logsdon with P. Ornstein and J. Pohle
6. Review analyses relating to backfill, shaft seal, and waste interaction (60.51(a)4) - J. Rhoderick
7. Design Criteria for underground facility (60.113) - J. Greeves
8. Design of Shaft and Borehole seals (60.134) - J. Rhoderick
9. Criteria for Waste Package with relations to the host environment (60.135) - D. Brooks with L. Pittiglio

*Qualitative Siting Criteria to which Modeling will Contribute:

Geochemistry : J. Starmer with J. Corrado

60.122 (b)3 & 4
60.122 (c)7, 8, & 9

Hydrology : T. Verma with P. Ornstein

60.122 (c)1, 2, 5, & 6

Geology : P. Prestholt with M. Pendelton

60.122 (c)4, 10, & 13

Design : M. Nataraja with D. Tiktinsky

60.122 (c)20 & 21

Estimated Required Resources:

3 staff days each for the findings (1-9).

1.5 staff days for each section of the siting criteria