

United States Government

Department of Energy

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ATTN OF: RW-24

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WM Project 1

SUBJECT: Performance Assessment National Review Group (PANRG)

109.2
(PANRG)

Docket No. _____

PDR

LPDR: _____

TO: D. Vieth, NV
L. Olson, RL
J. Neff, SRPO

Distribution:

Linehan / R. Johnson / Coplan
Weicht / Kennedy / Stablein
(Return to WM, 623-SS) *sf*

I would like to thank your staff and contractors for their participation at the first meeting of PANRG. The PANRG was very appreciative of the participation of the persons working in specific technical areas. Their participation was extremely helpful for a constructive and meaningful review. The discussions on regulatory requirements and methods of compliance provided a good basis for subsequent reviews.

The four PANRG meetings requested for May 8-10, May 30-31, June 27-28, and a meeting on unsaturated zone flow/stochastic modeling (unscheduled) have been consolidated into one meeting to minimize interference with EA and SCP program schedules. The Field Offices are requested to attend the PANRG meeting scheduled for July 9-13 at the Gaithersburg, Maryland Marriott Hotel. The meeting will address approaches to waste package/source term performance assessment, flow and transport performance assessment, and uncertainty and sensitivity analysis. Refer to the attachments for specific technical topics to be covered and meeting agenda.

PANRG has also requested a presentation by the NRC on waste package/source term. PANRG has suggested that SRPO/ONWI request Dr. John Wilson of INTERA and that RL request Drs. B. Sagar and P. Clifton of RHO-BWIP to attend the uncertainty and sensitivity analysis part of the meeting.

If you have any questions on either of these meetings, please contact Don Alexander at FTS 233-5596.

for *Ralph Stein*
J. William Bennett
Acting Associate Director
Office of Geologic Repository
Deployment
Office of Civilian Radioactive
Waste Management

Attachments

- cc: S. Mann, CH
- J. Jicha, DP-123
- ✓ J. Linehan, NRC
- J. Robertson, USGS
- E. Conti, NRC

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AGENDA

Performance Assessment National Review Group
 Second Meeting
 Gaithersburg, MD

Monday, July 9, 1984

| | | |
|------------|---|-------|
| 8:00 a.m. | Greetings, Introductions and Ground Rules | Lee |
| 8:15 a.m. | Tuff Source Term Presentation | NNWSI |
| 9:15 a.m. | Questions and Discussion of Tuff Source Term Approach | PANRG |
| 11:15 a.m. | Salt Source Term Presentation | ONWI |
| 12:15 p.m. | Lunch | |
| 1:00 p.m. | Questions and Discussion of Salt Source Term Approach | PANRG |
| 3:00 p.m. | Basalt Source Term Presentation | BWIP |
| 4:00 p.m. | Questions and Discussion of Basalt Source Term Approach | PANRG |
| 8:00 p.m. | Executive Session | PANRG |

Tuesday, July 10, 1984

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|------------|--|-------|
| 8:00 a.m. | Defense High Level Waste Form Performance Assessment | SRL |
| 8:30 a.m. | NRC Waste Package/Source Term Overview | NRC |
| 9:00 a.m. | Discussion of General Approach to Source Terms | PANRG |
| 12:00 p.m. | Lunch | |
| 1:00 p.m. | Canadian Performance Assessment Overview | Lyon |
| 1:30 p.m. | Tuff Radionuclide Transport Presentation | NNWSI |
| 2:30 p.m. | Discussion of Tuff Transport Approach | PANRG |
| 3:30 p.m. | Salt Radionuclide Transport Presentation | ONWI |
| 4:30 p.m. | Discussion of Salt Transport Approach | PANRG |
| 8:00 p.m. | Executive Session | PANRG |

Wednesday, July 11, 1984

| | | |
|------------|--|-------|
| 8:00 a.m. | Basalt Radionuclide Transport Presentation | BWIP |
| 9:00 a.m. | Discussion of Basalt Transport Approach | PANRG |
| 10:00 a.m. | Discussion of General Approach to Radionuclide Transport | PANRG |
| 12:00 p.m. | Lunch | |
| 1:00 p.m. | Tuff Geohydrologic Flow Presentation | NNWSI |
| 2:30 p.m. | Discussion of Tuff Geohydrologic Flow Approach | PANRG |
| 3:00 p.m. | Salt Geohydrologic Flow Presentation | ONWI |
| 4:30 p.m. | Discussion of Salt Geohydrologic Flow Approach | PANRG |
| 8:00 p.m. | Executive Session | PANRG |

Thursday, July 12, 1984

| | | |
|------------|---|-------|
| 8:00 a.m. | Basalt Geohydrologic Flow Presentation | BWIP |
| 9:30 a.m. | Discussion of Basalt Geohydrologic Flow Approach | PANRG |
| 10:00 a.m. | Discussion of General Approach to Evaluation of Flow | PANRG |
| 11:00 a.m. | Discussion of Stochastic Hydrology | PANRG |
| 12:00 p.m. | Lunch | |
| 1:00 p.m. | Basalt Sensitivity and Uncertainty Analysis Presentation | BWIP |
| 2:00 p.m. | Salt Sensitivity and Uncertainty Analysis Presentation | ONWI |
| 3:00 p.m. | Tuff Sensitivity and Uncertainty Analysis Presentation | NNWSI |
| 4:00 p.m. | Discussion on Sensitivity and Uncertainty Analyses Approaches | PANRG |
| 8:00 p.m. | Executive Session | PANRG |

Friday, July 13, 1984

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|------------|-------------------|--|
| 8:00 a.m. | Executive Session | |
| 12:00 p.m. | Adjourn | |

**Performance Assessment National Review Group
Request for Briefing**

The Performance Assessment National Review Group (PANRG) is formed to review the development, documentation, verification, validation and application of mathematical models to predict the transport of radionuclides from the waste package, through engineered and geologic barriers, into the environment. The Projects are requested to provide PANRG specific information as outlined. To the extent possible, please summarize specifics and results, and provide information on the basis of these results sufficient for a technical person to follow up in more detail. This may include excerpts from reports and draft reports, references to specific parts of reports and publications, etc.

To the extent possible, please follow this general outline for the presentations to PANRG:

- a. Present predictive techniques, including calculational methods; Identify computer codes or analytical approaches; Give mathematical formulations and key assumptions; Identify documentation, verification, benchmarking and validation plans and results; and Give input data, data sources and discussion of data validity.
- b. Present currently available results and conclusions.
- c. Discuss uncertainties in currently available results, analysis of such uncertainty, and plans for reducing such uncertainty.
- d. Give plans for improvements in predictive techniques and codes and identification of data needs, data collection plans and prospective use of such data.

I. SOURCE TERM

PANRG plans to review the approaches and results for:

- determining waste package lifetime;
- compliance with the release rate criterion for the engineered barrier systems; and
- formulation of the source term for site subsystem analysis.

This review will consider the present state of knowledge on source terms and the way in which such knowledge is being used in connection with other related project work (e.g., contaminant analysis) for the various repository projects. It will also consider plans for developing source terms which will be sufficient for DOE decisions on repository plans and for NRC licensing.

"Source term" refers to the time-dependent rate of release of radionuclide species from the engineered barrier system. If any other definition or interpretation is used, please explain.

Topics for Presentations

1. Radionuclide Inventory

Give assumptions in terms of original fuel (MTHM) charged to the reactor regarding: waste mix and quantities, reactor burnup, time since discharge from the reactor, reprocessing, etc. Please provide assumed inventories of specific radionuclides at time of emplacement and at 10, 100, 1000, 10,000, and 100,000 years after emplacement.

2. Assumed or Reference Engineered Barrier System

- Loading per package (in terms of MTHM originally charged to the reactor)
- Waste forms (material, composition, and detailed description)
- Container/overpacks (materials, thicknesses, other details)
- Backfill or buffer materials (materials, dimensions, other details)
- Other relevant engineered components (detailed description of backfill, seals, and other components included in your definition of the engineered barrier system).

3. Waste-Package-Scale Environments

- Expected thermal environments (temperatures in waste form, in waste package components, and in very-near-field rock at time of maximum, at emplacement, and at 10, 100, 1000, 10,000 and 100,000 years after emplacement)
- Nuclear radiation environments that could affect performance
- Stress environments that could affect performance
- Fluid conditions assumed (water volume, replacement rate)

4. Waste Package Failure

- Failure modes considered for Waste Package and Engineered Barrier System.
- Corrosion Process (uniform, pitting, vapor, crevice, stress, grain boundary)
- Effect of Temperature
- Hydrogen Embrittlement
- Radiolysis
- Effect of Corrosion Products

5. Leaching

- Solubility
- Waste Form Dissolution
- Other Processes Affecting Leach Rates
- Leaching Products
- Extrapolation of Laboratory Data to Repository Conditions and Time Scales

6. Radionuclide Transport

Please discuss approach for predicting the species of radionuclides and other major chemical components (e.g., iron species) and their concentrations that might leave the waste form (container/overpack) and move into the backfill material. Discuss retardation effects, retardation data for key radionuclides, and the approach to prediction of radionuclide migration through the engineered barrier system. Discuss diffusion coefficients. Discuss effect of colloids and coordination complexes on transport. Discuss treatment of radioactive decay during transport.

7. Chemical Processes

Discuss techniques for predicting the chemistry of any water that might contact the container/overpack in the post-closure phase, and the groundwater chemistry evolution adjacent to the package as a function of time. Discuss prediction of the chemical form of the radionuclides and other chemicals. Discuss solubility data for key radionuclides. Discuss impacts of diffusion of oxidants, radiolysis products.

8. Evaluation of Source Term for Site-Scale Transport Analyses

Discuss how the spatial distribution of canisters within a repository, that may extend for kilometers, influences the formulation of the source term for the site subsystem analysis.

II. GROUND-WATER FLOW

PANRG will review the approaches to modeling flow on the regional and local scale which are used to evaluate:

- Fastest path and travel time to the accessible environment and
- Input information for the evaluation of radionuclide transport.

The presentations should include details regarding the codes that will be used (viz., MAGNUM, PORFLO, SWENT or others) and the conceptual models to be used. The presentations should emphasize input data, results obtained, and validation.

On a regional scale, the presentations should discuss the conceptual models for the major sources of ground water and the information used to define the boundary conditions for the local-scale modeling. The local-scale modeling describes the flow in the vicinity of the repository including the effects of heat, partially-saturated flow, and interbed flow. The treatment of other sources of water at the sites (e.g., mineral dehydration) should also be discussed.

PANRG will also review the status of stochastic modeling of the hydrology. The presentations should discuss the extent to which these methods are being considered in the program and specific analyses that have been conducted or are contemplated.

III. RADIONUCLIDE TRANSPORT

PANRG is interested in the approaches and available results for the prediction of hydrogeologic transport of radionuclides, including:

- The cumulative releases of radionuclides to the accessible environment during the first 10,000 years after closure;
- Releases during the first 100,000 years;
- Time-dependent radionuclide concentration in major sources of ground water.

The following topics should be treated if they are relevant to a specific site.

- Evaluation of diffusion transport of radionuclides
- Formulation of dispersive transport in the transport equations, validity, dispersion coefficients, bases for dispersion coefficients, importance of dispersion in predicted results
- Data on chemical speciation, solubility, adsorption processes, effect of colloidal transport, ion exchange, isotopic exchange, uncertainties in such data and their integration into transport calculations
- Radionuclide diffusion into and out of dead-end pores
- Transport through and around repository seals and plugs

IV. UNCERTAINTY AND SENSITIVITY ANALYSIS

PANRG will review methods which are proposed for analyzing uncertainty and carrying out necessary sensitivity analyses for project guidance purposes and licensing. Presentations should include:

- Discussion of treatment of stochastic geohydrology;
- The approach and rationale for selecting the approach to other sensitivity and uncertainty analysis:
 - Monte Carlo
 - Latin Hypercube
 - Adjoint Method
 - Second-order Methods
 - Others

- Assumptions, details, and limitations in these approaches;
- Specific areas in which uncertainty and sensitivity analyses are contemplated;
- Whether different approaches are being considered for different specific areas;
- The extent to which calculations or analyses using bounding values may be appropriate in lieu of uncertainty analyses;
- Specific examples.