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P.W. Pomeroy 6/15/93

MINUTES OF THE ACNW WORKING GROUP MEETING ON PERFORMANCE ASSESSMENT FOR THE HIGH-LEVEL RADIOACTIVE WASTE MANAGEMENT PROGRAM DECEMBER 16, 1992, BETHESDA, MARYLAND

An Advisory Committee on Nuclear Waste (ACNW) Working Group meeting on Performance Assessment for the High-Level Radioactive Waste Management Program was convened by Working Group Chairman Paul W. Pomeroy at 8:30 a.m. on December 16, 1992 at 7920 Norfolk Avenue, Bethesda, Maryland. The purpose of this meeting was to clearly understand how research, laboratory and field work, and other analytical processes are factored into the methodology of performance assessment. Conversely, it was expected that the NRC and DOE participants would address how the modeling and performance assessment activities influence the information acquisition process. The entire meeting was open to the public. Giorgio Gnugnoli was the Designated Federal Official for the meeting. Appendix A contains a copy of the annotated agenda.

A list of meeting participants and attendees follows:

ACNW

Dr. Paul Pomeroy, Work Group Chairman
Dr. Dade W. Moeller, Chairman of the ACNW
Dr. Martin J. Steindler, Vice Chairman of the ACNW
Dr. William J. Hinze, ACNW Member
Dr. Mick Apted, ACNW Consultant, Intera Sciences
Mr. Paul Davis, ACNW Consultant, Sandia National Laboratories
Dr. David Okrent, ACNW Consultant

Participants:

Dr. Felton Bingham, Sandia National Laboratories
Dr. Jeremy Boak, U.S. Department of Energy
Dr. Holly Dockery, Sandia National Laboratories
Dr. Paul Eslinger, Battelle Pacific Northwest Laboratory
Dr. Buhdi Sagar, Center for Nuclear Waste Regulatory Analyses

NRC Staff Attendees:

M. Federline, NMSS
R. Wescott, NMSS
J. Linehan, NMSS
N. Eisenberg, NMSS
T. McCartin, RES
J. Trapp, NMSS
M. Byrne, NMSS
G. Colten-Bradley, NMSS
M. Silberberg, RES

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<u>NRC Staff Attendees</u> (Continued)

S. Coplan, OCM/KR
H. Atwood, NMSS
J. Park, NMSS
J. Bradbury, NMSS
R. Lewis, NMSS
J. Wolf, OGC
D. Chery, NMSS
R. Codell, NMSS
D. Fehringer, NMSS

<u>Other Attendees</u>:

G. Roseboom, U.S. Geological Survey
R. Wallace, U.S. Geological Survey
S. LeRoy, Office of Civilian Radioactive Waste Management/
Management & Operating Contractor (OCRWM/M&O)
J. Blair, OCRWM/M&O
S. Nesbitt, OCRWM/M&O
B. Packer, OCRWM/M&O
A. VanLuik, OCRWM/M&O
S. Sareen, OCRWM/M&O
P. Bunton, U.S. Department of Energy
A. Gil, U.S. Department of Energy
H. Minwalla, Weston
C. Charles, Weston
D. Dresser, Weston
B. Halsey, Lawrence Livermore National Laboratory
R. Barnard, Sandia National Laboratories
M. Wilson, Sandia National Laboratories
S. Frishman, State of Nevada
L. Lehman, State of Nevada
J. Walton, Center for Nuclear Waste Regulatory Analyses
R. Baca, Center for Nuclear Waste Regulatory Analyses
A. DeWispelare, Center for Nuclear Waste Regulatory Analyses
T. Jentz, NUS
A. Greenberg, RDA
D. Corson, ICF/KE
W. Russo, U.S. Environmental Protection Agency
T. Cameron, U.S. Environmental Protection Agency
A. Kubo, TRW
W. Matyskiela, TRW
L. Reiter, Nuclear Waste Technical Review Board

1. Opening Remarks

Dr. Pomeroy, Chairman of the Advisory Committee on Nuclear Waste (ACNW) Working Group on Performance Assessment for the High-Level Waste (HLW) Management Program, convened the meeting at 8:30 a.m. He acknowledged the preceding NRC/DOE Workshop (December 14-15, 1992) on Total Systems Performance Assessment (TSPA) in both NRC's and DOE's HLW Management Programs, which was held in this same meeting room.

He introduced the rest of the working group:

Dr. D. Moeller, Chairman of the ACNW
Dr. M. Steindler, Vice-Chairman of the ACNW
Dr. W. Hinze, ACNW Member
Dr. D. Okrent, ACNW Consultant
Dr. M. Apted, ACNW Consultant
Mr. P. Davis, Invited Expert

Dr. Pomeroy identified the subject as the current status of total systems performance assessment (TSPA) in the high-level radioactive (HLW) program. Both NRC and DOE efforts would be discussed. He characterized three main subtopics:

1. What is the current status of the HLW performance assessment (PA) program?

2. How have other efforts in the HLW program affected the evolution of the iterative performance assessment (IPA) and TSPA capabilities?

3. How have PA accomplishments affected the other efforts in the HLW program?

Specifically, he cited concern with the integration of research, laboratory and field work and other analytical data acquisition processes with the PA efforts. There were no other opening remarks by the working group participants. Dr. Pomeroy invited the NRC staff to begin their presentation.

M. Federline, Office of Nuclear Material Safety and Safeguards (NMSS) - Introduction to NRC's IPA for HLW

Ms. Federline indicated that higher priority work and some unexpected programmatic and technical setbacks limited the products of the IPA Phase 2 effort. However, she expected to provide the working group with an overview of NRC's IPA Phase 2 activities, a detailed example of the IPA process in a specific discipline (carbon-14 [^{14}C]), the use of expert judgment, and future considerations. She characterized PA as a valuable tool for the site investigator, the developer and the regulator, as well as a means for determining compliance with regulatory performance objectives.

Ms. Federline stressed the need for pre-licensing consultation between DOE and NRC, even though each agency has a different focus for PA. DOE will use TSPA to demonstrate compliance with NRC and EPA regulatory requirements; NRC must be able to independently evaluate DOE's demonstration of compliance. Hence, both agencies need to develop a PA capability. The preceding NRC/DOE Technical Exchange (December 14-15, 1992) served this consultation need. She observed that there were still many issues to be resolved in HLW PA.

Ms. Federline discussed the scope of the NRC's IPA effort. The NRC is not developing a redundant methodology, but a selective capability to focus on significant areas. NRC will rely on other methods, such as the Systematic Regulatory Analysis (SRA) and auxiliary analyses of specific detailed areas. The entire DOE TSPA will be reviewed only on a broad level.

Ms. Federline cited additional benefits of IPA:

- IPA provides useful information for NRC's evaluation of site characterization activities.
- IPA provides support in NRC's evaluation of the EPA's HLW standards.
- IPA provides input into development of NRC guidance documentation.
- IPA helps to integrate multi-disciplinary perspectives in analysis and research (e.g., interpretation of hydrology, geochemistry, metallurgy, etc., in the source term release model).
- IPA helps to identify technical uncertainties, which are addressed by defining research needs, more detailed auxiliary studies, etc.

Dr. Okrent stressed that the Energy Policy Act of 1992 (EnPA) focused on the National Academy of Science's (NAS's) charge to provide to EPA findings and recommendations on reasonable standards for protection of the public health and safety. He was concerned that in using the IPA to provide input to EPA's revision of the HLW standards, the NAS's charge would be lost in the details.

N. Eisenberg (NMSS) - Overview of NRC's PA Activities During IPA Phase 2

Dr. Eisenberg addressed NRC activities in Phase 2 of the IPA. He reiterated the benefits of IPA, as addressed by M. Federline. Additional objectives included the technology transfer from Sandia National Laboratories (SNL) to the Center for Nuclear Waste Regulatory Analyses (CNWRA) for technical and research support to NRC; as well as the evaluation of SNL's Tuff Methodology. He briefly discussed the NRC's IPA organization, which he characterized as a three-way partnership -- NMSS, Office of Nuclear Regulatory Research (RES) and CNWRA -- arranged as a six-team partition of the technical effort. These teams are:

1. System Code
2. Scenario Analysis
3. Flow and Transport
4. Source Term
5. Disruptive Consequences
6. Sensitivity and Uncertainty Analysis

In response to Dr. Okrent's concern regarding the six teams' focus on uncertainty, Dr. Eisenberg questioned whether the subject uncertainty was in the state of knowledge or in the natural variability of the system. Dr. Okrent indicated both comprised uncertainty. Mr. Davis distinguished between mathematical uncertainty, as opposed to the real uncertainties inherent in the modeling and in the system. Mr. Davis observed that the NRC's auxiliary analyses were directed to these real uncertainties. Dr. Okrent pursued the topic of uncertainties; specifically he asked whether the uncertainties were documented or just layered into the data input process. Dr. Eisenberg indicated that where uncertainties could be quantified and documented, they were. Otherwise, that would be characterized as an area needing more data, alternative models or auxiliary analyses. Dr. Eisenberg cited, as an example, the uncertainty in the NRC Phase 1 IPA effort with respect to chemical retardation of plutonium.

Dr. Eisenberg addressed the structural differences between NRC's Phase 1 and 2 IPA methods. He listed biosphere transport, dose computation, gas transport, and auxiliary analyses as major Phase 2 enhancements to the IPA. Some of the auxiliary analyses in Phase 2 of the NRC IPA include:

- Evaluation of the SNL-developed flow and transport codes (DCM3D & NEFTRAN II)
- Effects of layering, faulting and dipping on fluid flow
- Review of the U.S. Geological Survey's (USGS's) regional modeling approach

- Evaluation of the effectiveness of using K_d's in transport
- Retardation of ^{14}C in the geosphere
- Evaluation of source terms resulting from magmatic events

In response to Dr. Hinze's question on the meaning of "evaluation," Dr. Eisenberg indicated that there usually were insufficient data for true validation. Benchmarking by use of other computer codes -- either more complex or more widely accepted or both -- was used. Dr. Eisenberg pointed out that the NRC's sensitivity analysis was a formalized quantitative approach consisting of variation of the parameters (input and default) to evaluate the effect on performance.

Dr. Eisenberg reminded the working group that modeling natural systems is a relatively new enterprise. There is no ready supply of computer codes with a long history of use and engineering experience. Likewise, the data needed for code input are not fully understood; in some cases, the data result in having to change the model. He noted that classical validation was impossible because of the 10,000-year performance period. Partial validation and analogs appear to be the only validation strategies. He cited 10 CFR Part 60, Sections 60.21(c)(1)(ii)F, for the use of models and the requisite level of support (e.g., field tests, in-situ tests, analog data, etc.). He briefly touched on NRC involvement with international validation efforts; e.g., INTRAVAL and Swedish efforts.

Drs. Eisenberg and Apted discussed the applicability of using K_d's for geochemical transport interaction. Dr. Apted observed that use of the K_d approach could be made explicitly and in a uniformly conservative manner. Dr. Apted questioned serious reliance on other approaches (isotherm or non-linear sorption models). Mr. McCartin (RES) pointed out that in some situations the K_d=0 in order to be conservative; this excludes chemical retardation. Dr. Apted cautioned that reliance on auxiliary analysis could lead to open-ended research.

Dr. Eisenberg returned to the topic of specific enhancements in Phase 2 of the IPA. These included:

- Development of a system code, which executes the various modules representing various processes (e.g., source term release, transport, dose assessment)
- A limited dose assessment capability was added (DITTY) -- it calculates a population dose from various pathways: air, water, food chain, direct exposure, etc.
- Increase of scenario classes from 4 (Phase 1) to 16

- More sophisticated flow transport modeling for combined matrix/fractured media
- Gaseous transport and source term capability
- Saturated transport was added
- Improved treatment of the source term (mechanistic waste package failure and improved waste dissolution/transport)
- Expanded probabilistic analysis to include consequence modeling (several disruptive scenario classes)
- "Turn-key" sensitivity and uncertainty analysis -- production runs' output would be manipulated by the system code and a program software package to allow situation/scenario modification and sensitivity analysis

During the enhancements discussion, the following points were raised:

1. The limited dose assessment capability (using DITTY) would not provide an adequate estimate of individual dose. In that case, GENII would be used as a replacement module.

2. A more detailed description of the improved waste dissolution model was given. It addresses radioactive decay and ingrowth, advection and diffusion (simultaneously) and oxidation of the waste form.

3. In response to P. Davis' query regarding the planned strategy in going from IPA Phase 1 to Phase 2, etc., Dr. Eisenberg responded by referring to the conclusions in the documentation of the Phase 1 IPA (NUREG-1327). The future needs in research, data collection, and modeling were reflections by the NRC IPA "team" of the inadequacies in PA that needed to be addressed, either by NRC or DOE. The IPA Strategic Plan, which was urged on the NRC staff by the ACNW, will provide perspective on the priorities -- regulatory and technical -- for IPA as the process iterates.

4. Mr. Davis asked whether the subsequent approach to IPA was motivated by backing off from conservative complementary cumulative distribution functions (CCDFs) that violated the standards or by trying to identify inadequately addressed factors which could move an otherwise acceptable CCDF into a non-compliance result. Dr. Eisenberg responded that neither was the task of NRC; NRC had to evaluate DOE's claim of conservatism as acceptable or not.

Dr. Eisenberg addressed the expected products of IPA Phase 2. These included documentation of Phase 2 (NUREG-1464), computer code user's manuals, NUREGs on auxiliary analyses, professional papers, etc.

Other activities still ongoing in Phase 2 include:

- Continue testing all models in the NRC's Total System Code (TPA)
- Continue testing of the uncertainty and sensitivity analyses in the turn-key system code
- Documentation of auxiliary analyses
- Documentation of results

Rex Wescott (NMSS) - Overview of NRC's PA Activities - Changes in the HLW Program

Mr. Wescott discussed the various ground-water modeling computer codes, as modified for NRC's HLW PA capability. The contractors who contributed to this effort include:

Sandia National Laboratories (SNL)

Under contract to NRC, SNL developed the overall scenario methodology, as well as two of the water transport codes:

1. DCM3D - A dual continuum, 3-dimensional ground-water flow code for unsaturated, fractured, porous media.

2. NEFTRAN II - A network flow and transport code for calculating time integrated discharge and concentration -- it uses radionuclide transport velocities provided by DCM3D.

The Center for Nuclear Waste Regulatory Analyses (CNWRA)

The CNWRA assumed SNL's role in development of the PA capability and conducts the various research projects and experiments in geochemistry and waste package performance.

Other contributors include Lawrence Berkeley Laboratory (LBL), who developed the TOUGH computer model which is a multi-dimensional simulation of coupled transport processes (water, vapor, air and heat) in porous and fractured media. The University of Arizona is involved in natural analogs, such as the Apache Leap Tuff Studies.

The CNWRA performs auxiliary analyses involving ^{14}C transport, stress corrosion cracking (for use in the SOTEC model), saturated zone regional modeling (PORFLOW model), and effects of tilting stratigraphy and fault zones on ground-water velocity (BIGFLOW model).

The Apache Leap Studies provide inputs and perspectives to the PA effort; e.g., cross-borehole studies aid in evaluating and averaging scaling effects upon which the computer codes rely. In addition, analogs are indispensable for validation efforts.

Some observations during this presentation include:

1. Although the container material has not yet been selected, the process of evaluating candidate materials will provide a useful modeling protocol for whatever material is proposed.

2. Validation is still a partial process, because the analogs aren't sufficiently similar to the proposed Yucca Mountain site. However, there are sufficient parameters, processes and other aspects to analogs such as Apache Leap, which provide realistically useful data and inputs.

The IPA process resulted in some conclusions which included:

1. Phase 2 IPA activities resulted in the evaluation of volcanism and tectonics investigations as having a greater urgency than global climate research.

2. Development of SOTEC (Source Term Code) led to changes in the IWPE program for modeling pitting and crevice corrosion.

3. Structural analysis under repeated seismic loading was included in order to define realistic water package failure modes.

In the discussion following Mr. Wescott's summary of changes in the HLW Program resulting from the IPA process, the following observations were made:

1. Knowledge of the increase in precipitation is inadequate for estimating changes in potential infiltration; a better understanding of hydrologic conditions is necessary.

2. The IPA process has not yet produced any significant discovery which would lead to suggested changes in the site characterization.

3. There needs to be a screening of what processes to develop in detail and what processes to simply bound or eliminate

from the TSPA methodology. Due to the lack of sufficient information, skill and computer capabilities (and time), some difficult decisions must be made and priorities established. An unbounded search for complexity in modeling will only make the problem intractable.

N. Eisenberg (NMSS) - Lessons Learned from Phase 2 IPA

Dr. Eisenberg noted that the NRC staff and contractors have exercised the full system code to determine that it functions properly. However, sample runs addressing specific realistic scenarios at Yucca Mountain have not yet been performed. He observed that the Phase 1 PA modeling effort suffered from certain limitations; e.g., the lack of a mature site characterization data set, computer codes/models were only partially tested, and there had only been a limited peer review.

Dr. Eisenberg progressed to the general lessons learned from the Phase 2 IPA. He discussed these lessons under the following general topics:

1. Computer Needs - these included:

   - There needs to be closer coordination between the computer modelers and the scientific analysts.
   - A simplified systems code is needed to minimize computational run times.
   - Phase 2 computer facilities were inadequate.

2. Transportability of Computer Codes; in effect, computer codes function differently at different installations.

3. Due to the cost and complexity, it may be difficult to model ^{14}C release for compliance determination.

4. As far as waste package design is concerned, post-closure repository performance under seismic disturbance conditions has not been addressed by DOE. NRC staff had not expected this.

5. Technical Coordination - this included:

   - Coordination involved a greater degree of effort than was expected.
   - Separation of NMSS, RES and CNWRA by geographic distance proved to be a greater obstacle than was expected; a high speed communication link would have been extremely useful.

6. Project Management - this included:

   - Closer tracking is needed, taking into account resource expenditures, work accomplishments, and schedule.
   - Coordination of Phase 2 IPA with other related activities (e.g. research, technical assistance, etc.) resulted in extending the schedules.

Next, Dr. Eisenberg moved to the lessons learned by task; some of these lessons were discussed above; the following is not an exhaustive list:

- Additional support staff will be needed to maintain the system code.
- Additional efforts need to be allocated for software quality assurance.
- Present system code structure is not sufficiently flexible to handle variation in scenario initiation.
- Scenario probability appears to be independent of the sampling done for the consequence model; specifically, the probability of a scenario is independent of any of the sample parameters.
- Phase 2 did not exercise the "restart" capability of system code; i.e., pause code execution to permit parameter modification and then resume execution.
- The unsaturated fracture-flow problem for two-dimensional transport is computationally intensive; even steady state solutions present prolonged solution convergence times.
- Source-term code design is hampered by the different scales of releases; e.g., gas release is repository wide, whereas, liquid phase release is on a package scale.
- Source-term modeling complexity may control total systems code uncertainty -- package failure scenarios are complicated by synergisms (e.g., spallation, corrosion, shearing, etc.)
- Disruptive consequence modeling is complicated by coupling among different phenomena, because of the inherent difficulty of simulating the disruptive mechanisms in a computer model and because good data (for modeling purposes) are difficult to obtain.

Dr. Apted pointed out that the Electric Power Research Institute (EPRI) had performed a seismic disturbance study using expert elicitation; he indicated that EPRI found no "show stoppers" and that the report would be available in the near future.

R. Codell (NMSS) - Detailed Example of the IPA Process in a Specific Discipline: ^{14}Carbon

R. Codell acknowledged the contribution from the auxiliary analyses in support of the transport mechanisms to the ^{14}C portion of the system code. At Yucca Mountain, the ^{14}C associated with the spent fuel will likely be oxidized to carbon dioxide (CO_2), and because of the unsaturated nature of the site, that CO_2 could be transported to the accessible environment. He pointed out the facets and mechanisms leading to the ^{14}C release; e.g., coupling with other processes, heat transfer, fluid flow, multiphase components, etc.). He noted that ^{14}C in the waste form is contained in several compartments:

- The outside cladding and crud.
- The grain boundary and cladding gap.
- The oxidation products of the zircaloy.
- Oxidation products of spent fuel.

Mr. Codell noted that although the oxidized fuel only accounts for 60% of the ^{14}C inventory, it contributes the major "releasable" inventory. Assumptions made in modeling the release of ^{14}C included:

- No release of CO_2 is assumed until canister failure.
- Upon canister failure, no attenuation from cladding is assumed.
- The oxidation rate of ^{14}C is assumed to be the same as for the fuel.

The NRC staff relied on Battelle Pacific Northwest Laboratory (PNL) data on uranium fuel oxidation; e.g., thermal gravimetric data, grain growth on fuel slices, etc. The model was adjusted so that fuel oxidation in the model is realistic, but ^{14}C release was not keyed directly to data -- the rates are assumed to be equal. Dr. Steindler suggested that the Canadians have done more realistic work; Mr. Codell indicated that a shift to a more transient model in Phase 3 is expected to provide more realistic modeling.

Mr. Codell observed that the model is primarily sensitive to the temperature at the time of canister failure. In response to Dr. Moeller's question, he pointed out that radioactive decay is not a factor in the source term; it does, however, play a large role in the transport model (for ^{14}C). He noted that the NRC ^{14}C model simulates the flow mechanism as "particles" moving by means of the thermally-induced flow (advection) coupled with chemical interaction with other components in the geosphere. The auxiliary analysis configured a 1-dimensional transient flow/saturation/temperature/ chemistry mechanism keyed to the expected conditions in an unsaturated repository. He did note some deficiencies of the model; e.g., it does not include 2-phase flow and the retardation factor has a high degree of uncertainty.

D. Fehringer (NMSS) - Use of Expert Judgment in NRC's Licensing Process

Dr. Fehringer discussed his efforts to collect information and advice on how information is entered as evidence in the licensing process, as well as on how the process evaluates the validity of that information. His investigations included the NRC's Office of the General Counsel (OGC), as well as other sources including NRC staff with licensing experience. He pointed out that his presentation was a synthesis of these various sources and should not be misinterpreted to be fully representative of any one entity; e.g., OGC.

He proceeded to discuss the general licensing process, noting places where expert judgment will play a significant role from the NRC's standpoint; these include:

1. NRC staff preparation of the Safety Evaluation Report (SER) - the NRC staff will review the applicant's use of expert judgment.

2. Following NRC acceptance of the license application (LA), the NRC's SER and the DOE's LA will be provided to the licensing board for hearing -- here again testimony of experts will enter the proceeding.

3. Appeal to the Commission will replace the now defunct appeals board as the first level of appeal. The Commission has always been a forum for appeal, in any case.

4. The last step will be an appeal to a court. In this case, admissibility of scientific judgment is of greater concern; whereas the NRC hearing "boards" tend to be generous regarding testimony admissibility.

Next, Dr. Fehringer discussed the roles of expert judgment from pre-licensing interaction throughout the licensing reviews and final Commission review. Prior to the hearing process, the NRC limits the review of DOE's reliance on expert judgment to areas where there may be safety implications. Otherwise, it is not NRC's role to review DOE's methodologies. As the NRC's review progresses through the licensing process, it is not presently clear whether the NRC staff will focus only on the rationale (ignoring the process of elicitation) or whether the process will be reviewed to some extent. The situation is clearer at the hearing stage. Traditionally, the confrontational/cross-examination environment for expert-witness testimony is well established and expected.

Dr. Fehringer indicated that there are two criteria for admissibility of evidence in the hearing/appeals process:

1. The experts have established their expertise.

2. The judgments are relevant to the case.

He pointed out that Federal Rules of Evidence (FREs) are not really applicable to the license hearing process, but the licensing board may use FREs to some extent. He indicated that even though experts need not have firsthand knowledge of the facts, the judgment can be limited only to the witnesses' area of expertise. Dr. Fehringer also pointed out that the board and/or Commission are not bound by experts' judgments.

Other observations made during his presentation included:

- Panels can testify in a round-robin format.
- Weighting and combining judgments of experts can be a problem for a licensing board; the boards tend to prefer one model or one answer.
- There really is no assurance that DOE's expert judgments will prevail during licensing.
- The DOE can be assured that its judgments will be questioned and should strive to develop strategies to defend them.
- Rulemaking is an avenue which can limit the scope of challenge at the hearing stage; controversial issues can be addressed well before the license application stage.
- An alternative approach is to sequence separate hearings for each controversial issue.

Dr. Fehringer briefly discussed the NRC staff's intent to exercise an expert elicitation in the area of climatology. This will be an experiment for the staff to gain insight into experience in conducting explicit elicitations.

<u>D. Fehringer (NMSS) - Preliminary Plan for IPA Phase 2.5</u>

Dr. Fehringer explained that the NMSS staff was going to perform an elicitation exercise in the subject area of long-range climate change (over 10,000 years). Specifically an expert panel would be formed to address characteristics and probabilities for the climate scenario at the Nevada Test Site. He indicated that the purpose of the exercise is to provide experience for the NRC and its consultants in the process of expert elicitation, as well as to address the substantive aspects of climatic variability. One question to be answered is whether NRC should develop guidance in this area, and in what form the guidance should be. M. Federline indicated that the subject of the elicitation had been a point of deliberation among the staff. NMSS staff had considered using volcanism, but felt that such an exercise might be viewed as an attempt to pre-empt the DOE's own efforts in that area.

The elicitation mechanics involve a six-month schedule consisting of:

- A reputation survey to identify candidates
- Use of both normative, as well as substantive experts
- Conduct training followed by the elicitation
- Preparation of draft and final reports on the results of the elicitation

In response to Dr. Pomeroy's concern about the use of implicit judgment, M. Federline acknowledged that guidance would be difficult to develop for the full range of possible uses of expert judgment (implicit versus explicit, multiple versus single experts, etc.). Mr. Paul Davis raised the concern of who the experts would really be for long-range climatic predictions; could such "experts" be challenged, because there are none? Dr. Fehringer observed that licensing boards tended to be flexible in providing interested parties and litigation witnesses opportunities to present "evidence." M. Federline indicated that the staff was exploring the "qualifications of experts" issue.

<u>M. Federline (NMSS) - Considerations for Future NRC Performance Assessment (PA) Activities</u>

M. Federline acknowledged the need for a strategic plan to target and address those technical issues, which need to be evaluated by PA. A methodology is critical for addressing those issues prior to the licensing process in such a way that will provide adequate and timely guidance to DOE. She expects this methodology to be iterative, as is the IPA.

She cited the NRC's review and comment on the DOE's Total System Performance Assessments (TSPAs) and NRC interaction with the National Academy of Science (NAS) and EPA in the development of the HLW standard, as two critical efforts in the short-term goals in the planning strategy. Examples of fundamental PA issues which are targeted in the strategic planning process include:

- Validation
- Determination of scenario probabilities
- Scenario analysis/CCDF construction
- Use of expert judgment
- Flow in partially-saturated fractured media

Phase 3 of the IPA will consider:

- Refinements/improvements of existing Phase 2 NRC IPA codes and models
- Insights from the review of DOE's TSPA, specifically with respect to focused review on the use of NRC and/or DOE models in the specific disciplines
- Scope of impacts from the NAS study of the EPA HLW standard
- Technical uncertainties identified through the systematic regulatory analysis (SRA)

Ms. Federline listed examples of considerations resulting from DOE's TSPA exercises, which should be addressed in NRC's IPA efforts. These include model inter-comparisons, specifically in the areas of gas flow, source term, and unsaturated models. From the preceding workshop, comparability of the NRC and DOE scenario methodologies, as well as the CCDF construction, were areas needing further work. Mr. Davis (SNL) noted the absence of matrix/fracture flow as an item under consideration; he observed that the DOE and NRC approaches were very different.

Ms. Federline next addressed the Energy Policy Act of 1992 (EnPA) and its impact on the HLW IPA program at NRC. Topics which need to be considered are:

- Dose-based standards
- Individual protection standards
- Reliance on active institutional controls
- Supportability of probability estimates

Ms. Federline's final topic was the relationship of the IPA to the NRC's development of a license application review plan (LARP). She noted that PA will be used to focus NRC review on those technical areas that are most important to demonstrating compliance. The systematic regulatory analysis (SRA) effort will lead to the generation of the LARP. The draft LARP (expected in CY93) will be used for pre-licensing reviews. NRC efforts have, so far, focused on strategies for compliance determination. For example, LARP considerations for IPA would focus on concerns such as addressing technical uncertainties associated with the prediction of potentially adverse conditions; e.g., earthquakes.

Ms. Federline indicated that a report on Phase 2 IPA should be issued by the spring of 1993. She indicated that, as a result of the Phase 2 IPA exercise, a strategic plan for long-term PA would be developed for Phase 3 and beyond.

Observations raised following Ms. Federline's presentation included:

- The procedures and methods for establishing priorities should be addressed at an early stage of the NRC PA strategic plan.
- The degree to which the science drives the IPA is constrained by the relevance to the demonstration of compliance. Is it needed to demonstrate compliance with the standards?
- Auxiliary analyses will, hopefully, provide insight into code/parameter sensitivities and robustness, in areas where the tools (computer models) are too abstract.
- Both the NRC and the DOE indicated that the CCDF calculation addresses uncertainty and variability in estimating potential releases from the repository. The DOE indicated that, in dealing with incomplete knowledge of the natural processes and with the inherent variability in natural/engineered systems, some degree of confidence in an all-encompassing CCDF can be attained by adopting conservative parameters, models and probabilities in the calculus of the CCDF. The NRC sees value in presenting the "component" CCDFs, as well as the single CCDF cited by the EPA standards.
- The "reasonable assurance" qualifier in the EPA standards may require the use of both the single representative CCDF and the component CCDFs in order to document the rationale and justification for the compliance decision.
- Some participants expressed concern regarding which factors to consider in generating a CCDF, which factors need not be considered, as well as the criteria for distinguishing these factors. Others indicated that factors can either be expressed explicitly in the CCDF calculation or intrinsically as part of the process of addressing parameters, models, probabilities to be used in the CCDF calculation.

H. Dockery (SNL) - Total System Performance Assessment Exercise (TSPA-1 Overview)

Dr. H. Dockery indicated that she would concentrate on the TSPA-1 exercise with reference to the Performance Assessment Calculational Exercises (PACE) which constituted the last benchmark from which the TSPA was constructed. She characterized the DOE TSPA-1 exercise as consisting of a two-part effort involving SNL and PNL. She described the purposes of this combined TSPA effort as including:

- Initiating a series of iterative total system PAs, upon which DOE could improve the PA procedure and learn from mistakes.
- Reviewing system performance under representative conditions prior to site characterization.
- Providing guidance in site characterization.
- Developing the means and protocol for reducing the detailed models to simplified models needed for CCDF construction. The term "simplified" evolved to "abstracted"; these models can be very complex.

In further describing their roles, where SNL performed the abstract model calculations, PNL was providing the 2-dimensional calculations and the dose calculations. Los Alamos National Laboratory (LANL) provided the data and conceptualizations for the volcanic analysis and parameter distributions for retardation; Lawrence Livermore National Laboratory specified the source terms for SNL's use.

Dr. Dockery briefly reviewed the PACE effort. She pointed out that part of the objective of the PACE was to gain insight into the level of detail (in specifying lithologic layering, etc.) that would be necessary for simulations. The degree of detail was enhanced by performing 1-, 2- and 3-dimensional calculations of releases to the water table. She highlighted the following points:

- Multiple organizations were involved: SNL, PNL and LANL.
- The critical point of transition from all matrix flow to the initiation of fracture flow was 0.5 mm/year infiltration.
- Four radionuclides were considered in the source term: ^{237}Np, ^{129}I, ^{135}Cs, and ^{99}Tc.

In the transition to the TSPA, more phenomena (such as surface release) were modeled -- not just ground-water flow from the repository to the water table. Other enhancements included sensitivity studies, stochastic simulation and a larger suite of radionuclides.

In terms of the level of detail, some complexity was unnecessary; the number of distinct hydrostatigraphic units was reduced from 18 to 5. However, the source term became more sophisticated; improved understanding of the water contact modes and the addition of plutonium, americium and uranium isotopes -- as well as selinium and carbon (^{14}C) -- led to improved simulation.

Dr. Dockery addressed the scope of the TSPA, which consisted of the following mechanisms:

- Ground-water flow
- Gas flow
- Human intrusion
- Basaltic volcanism
- Tectonism

Each of these led to a "conditional" CCDF, which was then weighted and combined with the other CCDFs to produce the total system CCDF.

Dr. Dockery then focused on the transect which was modeled as representative of the repository. She pointed out the unlikelihood of drilling for water. The human intrusion scenario would likely be in the form of resource development drilling, where a pathway would be created for release into a deep aquifer. She acknowledged that expert judgment and analog information, as well as site data, were used to perform the TSPA exercises. The probability distribution functions for hydrologic properties (from expert elicitation) represented uncertainty, as well as the natural variability in those parameters. As better data are collected, the probability distributions, as well as other parameters, are revised to reflect the improved understanding of the natural system. In discussing the selection of parameter values, retardation coefficients, and boundary conditions, Dr. Dockery indicated that the infiltration was extended to 39 mm/year to compensate for possible climate change; even under realistic conditions it should not exceed 0.1 mm/year (possibly a maximum of 1.0 mm/year).

Dr. Dockery mentioned caveats to the TSPA-1 exercise, which included:

- Not all components were modeled.
- There is no validation of either the data or the models.

- The range of possible values was broad in order to address the uncertainty.

However, this exercise could assist in guiding site characterization. Following Dr. Dockery's presentation, some of the participants made the following observations:

- There is an effort to make the waste package design more robust; this would alter the near-field design vertical package assumed for the TSPA.
- Colloids were not addressed in this iteration of the TSPA with respect to ground-water transport.

F. Bingham (SNL) - Summary of TSPA Performed by SNL

Dr. Bingham indicated that he would depart from his prepared presentation in favor of addressing some of the questions and concerns that had already been raised during the meeting. He noted similarities with the NRC PA effort in that:

- The system model was the result of an abstraction process by which "simpler" models would produce the CCDFs.
- The more complex and mechanistic models substantiate the value of the simpler system models, and hence the value of the CCDFs.

He also acknowledged that the NRC staff heavily influenced the direction taken by the DOE in the TSPA exercise. The key to success in the abstraction process is validation, which is the process of convincing the regulator (NRC) to believe the analysis supporting the licensee's contention. Dr. Bingham displayed a logic tree for volcanism. This illustrated that the TSPA is one aspect of the process in which site characterization contributes to the total systems portion of the license application. The first step in validation is to bound the range of all possible events at the site; how could one be certain that nothing has been overlooked? The logic trees serve as "bookkeeping" devices for investigating actual and potential processes at the site. The tree approach permits an effective interactive and iterative means of using experts in the process of identifying the possible range of events, conditions and mechanisms at the proposed repository site. The logic trees provide a graphic aid in selecting what processes should be modeled and which ones need not be modeled. In the volcanism tree, he highlighted the branch corresponding to intrusion into the repository through the formation of a dike -- waste would be brought to the surface by the basaltic dike intersecting the waste canister(s). Even though the intrusion seems conceptually straightforward, the modeling is not. Assumptions need to be made regarding values of parameters such as dike width, canister location, etc. These parameters have associated distributions, which are elicited from experts.

At this point, Dr. Bingham addressed an aspect of the elicitation process, which has been a source of controversy. As the expert is asked questions regarding assumptions, parameters, distributions, etc., a software setup is able to use these answers to produce real-time resultant distributions and/or graphics to which the expert can react positively or negatively. The process is iterated until the expert feels comfortable with the results. The SNL participants consider this approach to be a useful tool for dealing with some of the problems associated with using expert judgment.

As an aside, Dr. Bingham indicated that this process of using trees, interactive feedback with experts, etc., will enhance the possibility of issue closure. If sufficient iteration with experts, detractors, and the public with regard to all the possible conditional CCDFs is performed, the belief is that the DOE can move on to other open/contentious "technical" issues.

Dr. Steindler asked if rulemaking would be used to close technical issues or whether this iterative conditional CCDF approach would be played out, and DOE would simply stop putting resources into it. Dr. Bingham acknowledged the usefulness of the rulemaking approach, but indicated that the choice would end up being DOE's.

Members of the NRC staff voiced support of efforts to try to close some of the issues, such as volcanism and erosion. The DOE has been developing staff technical positions (TPs), which appear to be viable vehicles for bringing up such issues for discussion and possible resolution.

Dr. Bingham turned to the subject of the source term and, specifically, the interaction between ground water and the waste container(s). He expressed skepticism with some of the scenarios being presented for that interaction, characterizing them as "ad hoc." He expressed dissatisfaction with the manner in which the source term is handled; he indicated more work was needed in this area. The degradation mechanisms leading to the source term are modeled in terms of distribution functions, and not "mechanistically."

Following the source term, SNL uses two models for the flow regime:

- The Composite Porosity Model, which is a mixed-flow model allowing matrix, fracture or both kinds of flow as functions of the flux level.
- The Weeps Model, which is a fracture-flow model.

He characterized these two models as bounding the range of possibilities for the flow regimes at Yucca Mountain. Since these two models could be used for a wide distribution of fluxes, he thought that the impacts of long-term climatic change could be folded into the analysis. Many of the participants -- both DOE and NRC consultants -- expressed the opinion that the climatic scenarios could adequately be addressed by variation of infiltration rates. Dr. Bingham speculated that the specific topic of infiltration rates or fluxes could be the one area where additional data, characterization and other empirical evidence may never be adequate for accurate modeling. However, the consequence analysis, using conceptual models, may indicate that the flux variation may not make a significant difference.

For the gas flow and gaseous releases, Dr. Bingham indicated that the source term scenario (for failure) is the same as for liquid releases (basically, container interaction with water leads to failure). However, ^{14}C plays the significant role. He emphasized the dependence of the gas flow lines for ^{14}C -- as well as the travel time -- on the repository temperature. The CCDF fails compliance with the Composite Porosity Model, but not with the Weeps model; this is a function of the percentage of containers interacting with ground water. The site characterization contingent of DOE can investigate key parameters to determine whether the assumptions are "too conservative." In that case, more focused site characterization may resolve the compliance problem under severely conservative conditions. These key parameters are part of the source term conditions and the container degradation assumptions and models.

Dr. Bingham raised the human intrusion issue. He characterized the two principal scenarios:

- Drilling into the repository and bringing HLW to the surface.
- Drilling through the repository zone and bringing waste into contact with the saturated zone.

Dr. Bingham indicated that SNL used the EPA-suggested guidance on drill hole frequency and density. However, he insisted that modeled compliance failure is, in reality, a hit-or-miss consideration. He noted that as the number of drill holes increased, the CCDF curves converged to noncompliance (at approximately 600 holes in 10,000 years). Because of the conservative assumptions in the intrusion scenario, the human intrusion consideration would likely be of little consequence.

Dr. Bingham then presented slides showing the overall CCDFs for the combined pathways (aqueous, gaseous, volcanism and drilling). Again, he noted that compliance failure with the composite-porosity assumption was primarily driven by gaseous ^{14}C.

Dr. Bingham listed the following technical conclusions:

- Gaseous releases are the most consequential.
- The human intrusion scenario cannot be ignored, but appears to be less important than previously believed.
- Direct releases caused by volcanism are inconsequential.
- The consequences are most sensitive to the manner of ground-water flow through Yucca Mountain.
- Unnecessary conservatisms, and hopefully uncertainty, need to be reduced.
- More sequences need to be factored into the modeling; e.g., indirect effects of volcanism.
- Thermal effects need to be addressed in the calculation of aqueous releases.

Dr. Bingham proceeded to discuss "lessons learned." He noted the following:

1. The computer codes need to "run" faster. Not just to shorten the speed of computing, but also to permit more mechanistic modeling in the systems code. He expressed some concern with the abstraction trend.

2. Computer codes need to be transportable (computationally robust irrespective of "machine"). Benchmarking exercises would be valuable, but cost and time limitations make this difficult. He thought that such benchmarking exercises between NRC and DOE could be very valuable and instructive.

3. ^{14}C is a problem for compliance and level of difficulty for realistic modeling (cost considerations). Better modeling is needed.

4. The effect of seismic disturbance on the waste package design seems to fall below the concern of drilling and ground-water interaction.

5. A useful and reliable systems code is still a formidable challenge.

For many of the other "lessons learned" expressed by NRC staff, Dr. Bingham expressed general overall agreement.

It was pointed out that benchmarking exercises have been conducted in the HYDROCOIN and INTRAVAL international validation efforts. In response to speculations that different parties exercising their separate codes would likely produce inconsistent results, Dr. Bingham agreed, especially if the codes were developed in relative isolation. Dr. Apted recommended anticipating differences in the codes prior to benchmarking exercises; otherwise, the exercise may not be as valuable.

Drs. Apted and Bingham expressed the opinion that the design of the container and of the emplacement strategy will rely heavily on the results of performance assessment. Dr. Bingham ventured his opinion that subsystem PA would have an even greater influence on the engineered barrier system (EBS) strategy.

Dr. Boak (DOE) indicated that LANL investigations demonstrated that varying thermal loads raised questions regarding the benefit from prolonged cooling. Dr. Steindler questioned the value of increasing the effort to be more mechanistic in the system code, simply because of the enormity of effort and time that it would involve.

Dr. Bingham completed his presentation by noting DOE's progress in meeting their purposes for this phase of their TSPA (TSPA-1):

- More detailed modeling is needed, as opposed to abstraction.
- Assembling data combinations is possible and may not be as large an obstacle as previously thought.
- TSPA does serve a guidance role for site characterization. This has been most effective in providing a means of direct communication between modelers and field investigators.

<u>P. Eslinger, Battelle Pacific Northwest Laboratories (PNL) - Summary of TSPA Performed by PNL</u>

Dr. Eslinger observed that the DOE has been funding a global climatology study since 1985, with special attention focused on the presence of the ice sheet, CO_2 forcing and other mechanisms. This would feed into regional modeling, which could provide insights into precipitation, and hopefully infiltration rates.

He discussed the differences between PNL and SNL TSPA efforts. These included:

- PNL used more detailed process models (2-D as opposed to 1-D; as well as a fully-transient, thermally-driven, gas-phase ^{14}C transport).
- Due to the level of detail, PNL ran fewer cases to produce the CCDF.
- PNL produced individual dose calculations for several release scenarios.

Dr. Eslinger addressed the processes modeled by PNL in TSPA-1. These differed from SNL's approach in that PNL included disruptions from tectonic activity. He noted that from the perspective of water table rise and subsequent infiltration, the consequences therefrom did not differ from those of the base case scenario. He exhibited a conditional CCDF on basaltic intrusion. Where SNL solicited expert elicitation of dike formations, PNL used a simplified model and global averages on dike formations. The PNL CCDF lay between the two SNL CCDFs.

Likewise in the area of human intrusion and volcanic intrusion, PNL and SNL took different approaches (e.g., intrusion nesting strategies), yet their results were very similar. In response to Dr. Steindler's question regarding an overall conclusion, Dr. Eslinger indicated that this supported a degree of robustness in the TSPA.

Dr. Eslinger next addressed the source term model (AREST). The AREST code is a mass transport model in the near-field. It is a more detailed analytical model than that used by SNL. Moreover, PNL considered both glass dissolution, as well as spent fuel.

In dealing with combinations of scenarios, he noted that the disruption scenarios were nested within base case computer runs. PNL grouped results with properties, which could be added statistically, to produce the overall CCDF. He noted that PNL limited the number of radionuclides to 10, as opposed to the 41 used by SNL. He further noted that using the EPA recommendation of 17 drill holes, PNL used a Poisson distribution for the drilling scenario, where the expected value of the distribution was 17.

Areas where SNL's and PNL's results were significantly different included the gas-phase scenario. PNL's model redistributed water within the mountain, as a result of the thermal load. This resulted in an effective gas flow barrier. Dr. Eslinger indicated that some limited site testing (G-tunnel) and site data supported this high saturation gas-flow block phenomenon.

Dr. Eslinger explained that there had been some convergence problems for those scenarios involving high infiltration rates (i.e., >0.5 mm/yr); this indicates that the mass transport was dominated by diffusion, not advection. Dr. Eslinger also pointed out that PNL'S models are independent from those used by SNL.

Next, Dr. Eslinger discussed the dose calculations. He reminded the participants that dose considerations evolved from the minimal role in the original standards (EPA, 1985) to the significant role specified in the EnPA. The PNL approach used the ICRP 26/30 models and assumptions. PNL focused on the base case and human intrusion. The assumed exposure times for these two target receptors were:

- Driller - 40-hour exposure, 50-year dose commitment
- Post-drilling dweller - 70-year exposure, 70-year dose commitment

Individual doses were not necessarily representative of those to the maximally-exposed individual, since cumulative releases were used. The ^{14}C dose was computed by assuming cumulative flux through the repository and specified parameter values for mixing volume (10 m), windspeed (3.3m/s), etc. These were input into TOSPAC, and resulted in doses in the range of tenths of a millirem. Dr. Eslinger observed that ninety percent of the dose resulted from <u>ingestion</u>, not inhalation.

SNL's runs for maximum release from the base case scenario indicated:

- The maximum release is predicted to occur in approximately 53,000 years.
- The maximum exposure pathway is drinking water with Tc and I as the dominant nuclides.

Dr. Eslinger summed up PNL's contributions as having:

- developed mathematical models for the scenarios,
- exercised the models with available data, and
- demonstrated that the models can be run.

He noted that the real goal of TSPA, or IPA for that matter, is to achieve regulatory convergence.

In response to Dr. Apted's question on the impact of decay chains to the maximum dose, Dr. Eslinger indicated that, with a full suite of radionuclides, the maximum dose may occur at a later time period than the 53,000 years mentioned.

There was some discussion on what the constraints of the biosphere with regard to exposure should be; i.e., should other ingestion pathways, besides drinking well water, play a significant role?

J. Boak, DOE - Future Direction for the DOE TSPA Activities

Dr. Boak began by highlighting those Fiscal Year 1993 priorities that would impact the degree of effort spent on PA. Items identified as needing support from the PA effort include:

- Supporting analyses for the Exploratory Studies Facility (ESF).
- Supporting analyses for the surface-based testing program.
- Supporting analyses for regulatory evaluations (input to NAS and EPA), including the following subtopics:
    - Dose calculation.
    - Uncertainty in the regulatory compliance period.
- Investigating the range of possible thermal loads at the repository.
- Indicating the future direction for TSPA-2.

With regard to the above list, Dr. Boak pointed out that much of the analyses to be done would be at the bottom of the PA pyramid; not the system code level of the TSPA, but rather at the mechanistic modeling level. He also noted that many of the highly desired benchmarking exercises have been reduced or postponed. Dr. Boak commented that a great deal of effort was directed to releasing the funds in order to proceed with the PA effort.

Dr. Boak noted that building scientific consensus is critical to progress in the HLW program. He characterized the decision analysis exercise (CHRBA, ESF alternative analysis, etc.) as articulating what the expected performance of the repository site would be (based on expert judgment and analytical efforts). This would be the basis for the scientific and regulatory consensus. Site characterization would be the confirmatory evidence for the consensus. DOE would stand by its conclusion of site performance, until a more robust conflicting conclusion could be advanced.

Dr. Boak described the potential scope for TSPA-2. The topics for TSPA-2 include:

- thermal effects on fluid flow and transport
- incorporation of new site data (e.g., neutron drilling probe)

- scenario refinement and augmentation (e.g., indirect effects of volcanism/tectonism, etc.)
- enhanced sensitivity studies for correlation purposes (e.g., spatial and parametric correlation at the site, as well as the influence of lateral homogeneity)
- enhanced modeling of the saturated zone
- colloidal transport
- impacts of water table fluctuation

Dr. Boak acknowledged some changes, such as a new M&O contractor, as well as the M&O's major roles in problem definition and total system evaluation. He noted that the next TSPA document would be a single integrated product involving all the participants. In response to Dr. Pomeroy's inquiry, Dr. Boak expected that the systems analysis would feed into the PA, as well as into the other activities and investigations related to the repository site.

Dr. Boak discussed the participants in TSPA-2 and their roles:

- SNL will be involved in problem definition, scenario development, but will share total system evaluation with PNL.
- LLNL will concentrate on the source term and near-field evaluation; the EBS evaluation will primarily be done there.
- LBL, USGS, and LANL will continue to support areas such as hydrologic properties, geochemistry and INTRAVAL coordination.

Dr. Boak acknowledged the uncertainty in how NRC should deal with evaluation of the TSPA. He highlighted shortcomings in the TSPA, such as the need to model higher flux rates, as well as the progress and complexity involved in the source term. Other areas pertinent to NRC's determination of compliance will likely involve the treatment of volcanism and the combination/aggregation algorithm for the CCDFs.

Some participants expressed concern regarding the addition of dose models into an already complex calculation, especially if the DOE contractors are using models with independent pedigrees. Dr. Boak speculated that the diversity would have to be experienced, prior to the decision for a uniform approach.

Dr. Boak presented a schedule for the next iteration of TSPA -- TSPA-2 -- with a draft document publication date by the second quarter of FY94.

From present indications, the process of producing this draft TSPA-2 publication does not appear to be adequate to satisfy NRC QA requirements.

Dr. Boak moved on to the topic of integration of program activities. He mentioned DOE's intent to submit issue resolution documents to NRC, which could consist of a suite of data with respect to an open or contentious issue -- such as volcanism -- for a decision from a licensing adequacy standpoint. In effect, can some issues be closed or sufficiently characterized so that no new data are needed?

Round Table Discussion

Mr. S. Frishman (Nevada) referred to the EnPA and its impact on the HLW program, specifically in the area of PA. He interprets this mandate to require a cleanup of the entire Nevada Test Site (NTS) because of the potential for inseparability of the contributions to dose from the NTS and the HLW repository. He also cited literature that the increased thermal load could lead to increases of radon exhalation from the surrounding soil.

Ms. Federline (NRC/NMSS) reinforced the importance of DOE's iterative PA efforts to ensure that site characterization will produce the data necessary to measure performance. She supported the need for more detailed models; she cautioned that total system analysis should prioritize and guide the direction of PA. She stressed that, as a byproduct, the PA process should produce skilled analysts who will have the insight to carefully weigh the integrated system.

Dr. N. Eisenberg (NRC/NMSS) highlighted that there is a suite of PA codes, not just one. Questions of licensability will be argued at many levels of these codes. NRC and DOE need to be able to address these levels.

Dr. Steindler raised three points:

- It is not clear how expert judgment can be confidently incorporated in the PA and licensing processes.
- The drive towards more mechanistic codes -- as opposed to probabilistic ones -- is in conflict with the goal of issue closure.
- The program needs to be able to defend the algorithms used to "speed up" the machine run times; i.e., the abstracted total system code; as well as the assumptions used. The limitations must be known and justifiable.

- Finally, he stressed that the laboratory and field information being collected are relevant to the goal of describing the repository performance realistically.

Dr. Pomeroy adjourned the meeting at 6:48 p.m.

UNITED STATES
NUCLEAR REGULATORY COMMISSION
ADVISORY COMMITTEE ON NUCLEAR WASTE
WASHINGTON, D.C. 20555

SCHEDULE AND OUTLINE FOR DISCUSSION
ACNW WORKING GROUP MEETING ON PERFORMANCE ASSESSMENT FOR THE HIGH-LEVELWASTE MANAGEMENT PROGRAM
DECEMBER 16, 1992

Wednesday, December 16, 1992, Room P-110, 7920 Norfolk Avenue, Bethesda, Maryland

	Time	Agenda Item	Discussion Lead
1)	8:30 - 8:~~45~~ 38 a.m.	Opening Remarks by Working Group Chairman (Open) (PWP/GNG) 1.1) Introduction of Consultants 1.2) Opening Remarks	P. Pomeroy (ACNW)
2)	8:~~45~~ 38 - ~~9:05~~ 8:52 a.m.	Introduction to NRC's Iterative Performance Assessment (IPA) for HLW (Open) (PWP/GNG)	M. Federline (NRC/HLWM)
3)	~~9:05~~ 8:52 - ~~10:05~~ 11:45 a.m.	Overview of NRC's Performance Assessment Activities During IPA Phase 2 (Open) (PWP/GNG) 3.1) Changes from Phase 1 to Phase 2 3.2) Changes in the IPA Methodology Resulting from research and other HLW investigations 3.3) Changes in the HLW Program Resulting from the IPA Process 3.4) Lessons Learned	N. Eisenberg R. Wescott (NRC/HLWM)
	10:~~05~~ 45 - ~~10:20~~ 11:05 a.m.	***** BREAK *****	
4)	~~10:20~~ 11:45 - ~~11:20~~ 12:19 P ~~a~~.m.	Detailed Example of the IPA Process in a Specific Discipline -- Carbon-14 (Open) (PWP/GNG)	R. Codell (NRC/HLWM)
5)	~~11:20~~ 1:26 - ~~12:20~~ 2:08 p.m.	Use of Expert Judgment in NRC's Licensing Process (Open) (PWP/GNG)	D. Fehringer (NRC/HLWM)
	12:~~20~~ 19 - 1:2~~0~~ 6 p.m.	***** LUNCH *****	
6)	~~1:20~~ 2:08 - ~~2:00~~ 2:47 p.m.	Considerations for Future NRC Performance Assessment Activities (Open) (PWP/GNG) 6.1) Short-term (IPA Beyond Phase 2) 6.2) Long-term (Strategic Plan for IPA)	M. Federline NRC Staff
7)	~~2:00~~ 3:00 - ~~2:40~~ 3:38 p.m.	Overview of the DOE Performance Assessment Program from PACE to TSPA 1991 (Open) (PWP/GNG)	H. Dockery (SNL)
	~~2:40~~ 2:47 - ~~2:55~~ 3:00 p.m.	***** BREAK *****	

APPENDIX A

{ = Transcribed portions

8)	3:38 - 5:02 ~~2:56~~ - ~~4:15~~ p.m.	<u>Summary of TSPA Performed by SNL</u> (Open) (PWP/GNG)	F. Bingham (SNL)
9)	5:02 5:39 ~~4:15~~ - ~~5:35~~ p.m.	<u>Summary of TSPA Performed by PNL</u> (Open) (PWP/GNG) 9.1) Similarities and Differences between SNL and PNL TSPA	P. Eslinger (PNL)
10)	5:40 - 6:30 ~~5:35~~ - ~~6:15~~ p.m.	<u>Future Direction for the DOE TSPA Activities</u> (Open) (PWP/GNG)	J. Boak (DOE/YMPO)
11)	6:30 6:48 ~~6:15~~ - ~~6:45~~ p.m.	Round Table Discussion	NRC, DOE, & State of Nevada
	6:48 ~~6:45~~ p.m.	*** ADJOURN ***	