

CENTER FOR NUCLEAR WASTE REGULATORY ANALYSES

TRIP REPORT

SUBJECT: Sixth Annual International High-Level Waste Management Conference and Exposition [20-5702-421 (50%) and 20-5702-423 (50%)]

DATE/PLACE: April 30 through May 5, 1995. Mirage Hotel, Las Vegas, Nevada.

AUTHOR: Michael P. Miklas, Jr.

PERSONS PRESENT: R. Baca, R. Bagtzoglou, R. Brient, A. DeWispelare, R. Green, B. Henderson, B. Hill, R. Hofmann, P. Mackin, H. Manaktala, M. Miklas, S. Mohanty, W. Patrick, J. Russell, B. Sagar, G. Stirewalt, S. Stothoff, and D. Turner (All from CNWRA). Approximately 750 other attendees too numerous to mention individually.

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BACKGROUND:

The Sixth Annual International High-Level Radioactive Waste Management Conference and Exposition was a meeting of many of the individuals active in the evaluation and planning for the disposal of high-level radioactive waste in the world. A significant east-European contingent was evident. Papers and plenaries devoted to high-level radioactive waste management were presented for 4-days with a 5th day field trip to the proposed Yucca Mountain geologic repository site hosted by the Department of Energy (DOE).

SUMMARY OF SELECTED PAPERS AND PLENARIES:

Approaches To Regulatory Compliance

1. J. Curtiss (Winston and Strawn, former NRC Commissioner) gave J. Michael McGarry's presentation on the Use of Modeling in Repository Licensing. A copy of this paper and supporting materials is being circulated to the staff. Key points of his presentation were that modeling adequacy is related to: (i) the ability of the model to address regulatory goals; (ii) appropriate use of simplification and "reasonably conservative" approaches; and (iii) recognition and appropriate treatment of uncertainties in the model validation process. He reviewed a number of case studies of both successful and unsuccessful applications of models in the licensing arena.
2. N. Eisenberg (NRC) gave basically the same presentation as was presented to the PAAG and GEOVAL concerning the SKI/NRC joint study on model validation. The basic approach is one of building confidence in estimates of performance rather than developing scientific proofs.

Communicating Risk: Alternative Views

1. B. Cohen (University of Pittsburgh) gave an overview presentation on relative risk comparison. He compared spent fuel toxicity at various ages out of core with the toxicity of various other metals. There is a wide body of literature in this area, to which Cohen has contributed significantly over the years.
2. B. Crowe (LANL) described the approach that he believes is being implemented to address the issue of volcanism. He described how they consider all probabilities that have been put forward, limit this range by what he calls "reasonable bounds", and then set up a triangular distribution across the resulting range. The basic theme was that all of the probabilities that result from this process are essentially the same. Crowe described the role of the scientist as one of "developing unbiased scientific data" which can then be modified and interpreted by others, as appropriate, for use in the regulatory and decision-making process.
3. A. Dirks Stevens (SAIC, Idaho Falls) spoke on the role of "empowerment" in risk communication. Her basic thesis was that the appropriate context must be established before the correct scientific content can be effectively communicated. The results of her surveys and studies indicate that the "not-in-my-back-yard" (NIMBY) attitude is not based on assessment of risk, *per se*, but on fundamental issues of "sovereignty" and "empowerment" in the decision-making process. People want to have control (or at least an influence) over their physical and ideological home.

Gaseous Flow and Transport

1. "Gasgeodynamical Method for the Assessment of Rock Massif for RAW Disposal" by I.D. Bagriy, V.M. Paliy (Geological Inst-Ukraine), and Y. A. Yakolev (Ukrainian State Geological Committee) described a method in which 2-foot deep holes are drilled and gas is sampled. A suite of gases is analyzed (presumably by chromatography). A large area (5000 km²) is first sampled with widely spaced holes. The purpose of the analyses is to locate faults by identifying the gaseous emanations that flow upward in the higher permeability fault planes. After gross analysis areas with little concentration are then sampled in successively finer grids to find target areas with few or no deep faults. The concept of placing waste in an area with no or very few faults contrasts sharply with the highly fractured and faulted Yucca Mountain area. GAZPROM is a company that has been formed to market this exploratory technology.

Impacts/Perceptions: Moving Away From Nuclear Waste

1. H. Jenkins-Smith (UNM) reported the results of extensive surveys conducted by the UNM Institute for Public Policy regarding social, economic, and perceived risk issues. He highlighted the importance of comparing local responses to a broader national survey to determine whether the local population was more or less concerned about particular factors. UNM studies show that, contrary to the views of many, the public recognizes that doing nothing is not free in terms of economic and other impacts. The notion of "stigma" associated with hosting waste sites is not yet well understood.
2. D. Soden (UNLV) reported on a survey concerning factors which effect migration within (or out of) rural communities in Nevada. He characterized these communities as areas of few

opportunities, boom-bust economies, high unemployment, and strong influence of particular religious groups. These characteristics result in decision-making being largely economically driven. Of those surveyed, 95% expressed that a nearby repository would not influence their decision to stay in the community (i.e. there is apparently a low stigma in these communities for hosting a repository).

Model Abstraction for Performance Assessment-I

1. The presentations in this session were primarily philosophical in nature with relatively little new or novel. John H. Kessler (EPRI), for example, stated that the EPRI Total-System Performance Assessment (TSPA) approach was to use very simple and conservative models which are applied to evaluate compliance with the EPA regulation. Kessler indicated that if these calculations did not show compliance then the model would be improved and made more realistic. This suggests that EPRI has already concluded that YM is an acceptable site and they will continue to develop PA models that will indeed show this. R.W. Nelson gave a presentation in which he identified the need to test abstractions used in TSPAs. The basic approach outlined was to compare calculations from process-based (or detailed) with those from simpler models. While this approach is intuitively appealing, the presentation was vague on specifics of what and how these results would be compared and what level of agreement (or lack of agreement) would be used to make a determination. B. Dverstorp (SKI) gave an interesting presentation where he showed that multiple PA calculations, ranging from simple hand calculations to sophisticated stochastic model simulations. The point of his presentation was that diverse approaches for PA calculations can and should be compared for individual performance measures (e.g. groundwater travel time) to gain a perspective on the possible range of outcomes. This builds confidence in the analysis results because the PA approach is very systematic, thorough, and examines the realm of possibilities using distinct conceptual and calculational methods.

Nuclear Analysis - Criticality, Shielding, Source Terms

1. The presentations addressed all three topics covering the spent fuel axial burnup profile data base, long-term criticality aspects of the Multi-Purpose Canister (MPC) design, dry fuel storage cask shielding benchmarks, and a status of ORIGEN-ARP code that will be more appropriate to generate neutron cross-section library for depletion and decay calculations for the radionuclide inventory in HLW. The papers generally presented the progress on ongoing projects, including the schedule for submittal of the burnup credit topical reports to the NRC. Considerable analyses have been performed for the burnup credit since the last meeting, and the preliminary data indicate that allowance of burnup credit is expected to show that there are no criticality concerns during the design life of the waste package. However, there are still some open issues regarding much longer times and of some scenarios that are currently not included in the studies. Questions related to the scenario(s) leading to criticality at the Yucca Mountain site, developed by S. Bowman of LANL, and recently reported in the press also came up during the session. Although, this particular issue is not directly related to the MPC, but to repository performance, there was a concern that the much larger size MPC design waste packages (compared to the SCP design waste packages) could contribute adversely to the issues of criticality safety at the repository site.

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Performance Assessment—General Issues

1. This session included presentations on siting of the repository site in Sweden, implication of colloids on the performance of a HLW repository, description of an approach to model colloid-facilitated transport, issues related to disposal of TRU waste at the WIPP site, and systems approach to performance assessment. There was considerable interest in the paper on the implication of colloids on the HLW performance with several exchanges of questions and answers. The audience was convinced that a considerable amount of colloids will exist in the ground waters, with additional formation of colloids due to repository construction activities, introduction of waste package and EBS materials, and the spent fuel and vitrified waste forms. The area of future interest is the generation of additional data and analyses related to transport of radiocolloids in a Yucca Mountain repository environment. It was the general opinion of the attendees that very little information relevant to the natural systems is currently available to exercise any current or proposed performance assessment models to estimate the performance of HLW at the Yucca Mountain repository site. It was felt that near-future work ought to concentrate on sensitivity or bounding analyses to identify clearly some focused but limited areas requiring laboratory experimental investigations. DOE's planned TSPA-95 will probably include some elementary treatment of the subject of colloids mediated transport of radionuclides. The subject is clearly of considerable interest with several uncertainties in the magnitude of the contribution from radionuclides in colloidal form to the overall performance of the repository. More quantitative information is expected at future meetings.

Regulatory Issues/Interactions

1. L. Berkowitz (TESS) discussed workshops that DOE has conducted. Since DOE has no HLRW repository licensing experience, and technical staffs are not familiar with the level of documentation and justification necessary to support a license application, these workshops have been of significant value. The licensing process, role of the applicant and regulator, and interacting with regulators were covered in the workshops. Similar orientation may be beneficial to NRC and CNWRA technical staff, particularly on how regulators should interact with the DOE in technical exchanges and other situations.
2. J. Boone (Duke Eng) discussed recent progress in the LSS. In June, 1994, the YM Site Characterization Office restarted LSS activities after recognizing that LSS could be on the critical path of a 2001 license application. Seven alternatives, all having digital text file, image, and bibliographic header capability were evaluated, and four of the alternatives projected costs savings of \$40M from earlier estimates of life-cycle costs. The author presented a very optimistic picture. Some NRC staff present had been briefed on LSS the previous week. Their impression was that Boone's optimistic outlook seemed to conflict with that of the earlier briefing.

Site Scale Flow and Transport

1. S. Finsterle, G. Bodvarsson, and G. Chen (LBL) presented some preliminary results from their inverse modeling efforts at Yucca Mountain. Their major conclusion was that in order to match the data, infiltration rates must be much lower (by an order of magnitude) than the infiltration rates calculated by A. Flint and L. Flint and presented in their maps depicting the distribution of infiltration rates at Yucca Mountain. However, an important caveat of this study was that their analyses did not include the effects of fractures.

2. G. Bodvarsson, Z. Aunzo, G. Chen, C. Haukwa (LBL), A. Flint, L. Flint, and E. Kwicklis (USGS) gave a presentation that attempted to address the State of Nevada concerns regarding the pneumatic pathway issue at Yucca Mountain. Their preliminary results indicated that the Paintbrush Tuff non-welded unit (PTn) acts primarily as a porous medium with substantial storage capacity. As a consequence, and even though there is ample pneumatic communication between the top of the mountain and the Topopah Spring welded unit (TSw), there exist two almost independent vapor circulation patterns; a rather shallow one above the PTn and another, extending much deeper, below the PTn.
3. W. Zhou and M. Apted (Intera) made a presentation dealing with flow and transport simulations using dual-porosity models. The matrix-fracture interaction term was calculated based on the empirical formula by Kazemi and is based on fracture spacings in each of the three dimensions. Their study concluded that at steady-state, fractures are totally dry, indicating complete imbibition, and matrix flow is dominant for infiltration rates less than approximately 0.1 to 0.5 mm/yr.

Social and Ethical Issues Surrounding High-Level Waste (Plenary)

This plenary session featured a cross-section of senior individuals from the international HLW community. The representative from the State of Nevada (D. Titus) did not attend.

1. Per-Eric Ahlstrom (SKB-Sweden) identified four major aspects to an ethical approach to HLW management. These are: (i) it is important to make decisions and execute the program in a manner which shows progress; (ii) a stepwise approach should be taken in site selection, characterization, design, and development; (iii) local citizen concerns must be recognized and incorporated in decision-making; and (iv) future decision-makers should be given a reasonable "freedom of choice." Under the later point, he called for action now which avoided passing the burden of waste management on to the next generation but which also gave the next generation the opportunity to change the decision (e.g. through retrieval and reprocessing).
2. Colin Allan (AECL-Canada) continued on a similar theme of balancing the execution of current responsibilities with provision for future generations to change the disposal decision. He developed three themes. First, risk perception is at the root of acceptance of waste disposal. From his studies, he concluded that consequence, not probability of occurrence, is the principal concern. Furthermore, there is a sense that predictive modeling cannot be relied on as the basis for decision-making. He offered that the "risk perception gap" can be closed by (i) giving the public a measure of "control" of the decision-making process; (ii) implementing decisions that are reversible; (iii) monitoring the repository; (iv) taking a phased approach; (v) providing benefits and impact management for the affected communities; and (vi) relying on voluntary siting. Second, ethical considerations should be based on a consistent set of values, a sense of fairness or equity, and recognition of the rights and responsibilities of the various parties. In this context, he called for producers of the waste to be responsible for health, safety, financing, and environmental protection. Third, implementation principles must be consistent with actions taken to address risk perception and ethics.
3. Maurice Allegre (ANDRA-France) declared that "democracy" was essential in siting waste management facilities. This is particularly interesting in light of France's historical approach of proceeding with no public knowledge, let alone public involvement. He referred to the historical

approach as one of "Technologically Enlightened Despotism." In particular, he expressed the strong view that doing nothing (i.e. deferring the decision to the future) violated essentially all ethical principles.

4. Craig Walton based his ethical position on fundamentals drawn from the teachings of Aristotle, the Federalist Papers, and the Constitution. Declaring the entire waste management program to be "morally flawed", he proceeded to delineate four areas of ethical concern. First, the professional ethics of the scientists and engineers are in question because of how they address Type 1 and Type 2 errors in their investigations. He believes that the approach being used is: unless proven unsafe, then safe. Second, the potential for human error has not been included in the analyses and evaluations. This is wholly inconsistent with experience regarding the role of human factors in complex system performance. Third, the role of the public was reduced by the NWP. He castigated DOE for how they have handled the public information meetings: questions and comments are taken but not responded to until many months later and then only in a published report rather than face-to-face. Fourth, impacts on future generations are not adequately addressed.
5. Carol Silva (University of New Mexico) gave a very cogent presentation on the role of values in scientific judgments. She noted that performance assessment must be structured and communicated so that it operates across three domains: science, regulation, and public policy. Silva also highlighted the importance of the independence of scientists from those who fund their work. This is a central issue of scientific trustworthiness. Finally, she noted that, as a group, private contractors are seen by the public to be the least neutral (i.e. the most biased): 20% of those polled thought private contractors would be neutral, versus 70% for the NAS.

Spatial Variability

1. S. McKenna and V. Tidwell (SNL) presented a comparison of numerical upscaling techniques for constitutive properties. In this study, three major upscaling approaches were compared: (i) geometric mean, (ii) power law averaging, and (iii) renormalization group. The comparisons were made for saturated hydraulic conductivity and used two performance criteria: (i) how well did the three approaches do against direct (exhaustive and much more computationally demanding) numerical simulation hydraulic conductivity upscaling estimates, and (ii) how well did the three upscaling methods predict the groundwater travel time (GWTT) associated with the flow problem? The main conclusions of the study were: (i) the power law averaging works well for bulk effective hydraulic conductivity estimates associated with regularly and arbitrarily shaped computational cells. The renormalization group works well for regular cells but does not perform satisfactorily for arbitrarily shaped cells.; (ii) the geometric mean performs equally well with the renormalization group method, in most cases, but suffers greatly when dealing with skewed parameter distributions.; and (iii) all three approaches perform reasonably well for GWTT evaluation, however, the geometric mean provides more accurate estimates of fastest paths than the renormalization group and power law approaches.

Subsurface Facilities Design

1. R. B. Hofmann (CNWRA) and A.K. Ibrahim (NRC) presented results from a YM seismic hazard analysis using published data in lieu of elicitation of experts. The authors pointed out that a considerable amount of new data was being developed by DOE which would influence such

analyses in the future. A graph of hazard analyses results from 1975 to 1995 versus year of publication suggests that two hazard values (about 0.25g or about 0.65g for a 10^{-4} event per year depending on the models used) predominated for an aggregate of the years. When queried, R. Hofmann commented that NRC/CNWRA intended to make more seismic hazard calculations in the future because DOE's logic tree approach which permits alternative not-peer-reviewed analysis methods would need to be verified with some NRC/CNWRA parallel calculations.

2. J.C. Stepp (Woodward-Clyde) and others presented a condensation of the DOE "Seismic" Topical Report 1. Four design or performance categories of structures, each with a different associated probabilistic hazard (acceleration or ground motion spectra) were discussed. Responding to a question Stepp stated that it was a consensus of practicing engineers that the building code design methods proposed were adequately conservative even in the light of the extensive damage caused by a moderate $M=6.7$ earthquake at Northridge, California. Hossain (a co-author) responded that only the first two performance categories would be designed with building code methods and that other techniques would be used for the two more important categories of structures. Perhaps when DOE completes its Topical Report 2 the differences in methods for the two groups of performance categories will be made more clear.

Topics in Performance Assessment Analyses

1. T. Eng (SKB) gave a presentation on scenario development methodologies. He presented two distinct methods for examining scenarios which employ influence diagrams and an interaction matrix. These methodologies appear useful in interrelating scenarios in a highly detailed manner. The influence diagram approach has some similarity to event and fault trees. The interaction matrix contains expert based information on the significance of the coupling. This methodology is primarily a visualization tool and useful in the selection and representation of scenario classes. It may be beneficial to examine this approach under PA Research.

Waste Form Alteration - Spent Fuel and Cladding

1. Finn et al. (ANL) reemphasized in the paper on alteration of spent fuel matrix under unsaturated water conditions, that the majority of releases from the spent fuel (over geologic time) will be controlled by the formation of alteration products on the surface of the spent fuel. The dissolution/degradation kinetics of these secondary minerals need more careful studies versus the current efforts at various labs studying the dissolution kinetics of UO_2 . Data presented showed that release kinetics after exhibiting a slow but systematic decrease with time could in fact increase considerably at longer times. Data for 3+ years of experiments ongoing at ANL were shown as evidence.
2. Other papers in the session generally presented information that was widely known but not necessarily accepted by everyone. One paper on modelling of wastefroms from the pyroprocess fuel cycle summarized the results of a doctoral thesis at Iowa State University. The activities by DOE in this area have been discontinued for lack of funding.

Waste Management Decision Science

1. R. Perman (Geomatrix Consultants) spoke about assessing volcanic hazard at Yucca Mountain using expert judgement. This talk was particularly interesting because some members of the

expert judgement group are intimately involved with site characterization and developing models of volcanism at Yucca Mountain for DOE. The group was deliberately selected to get as much of a knowledge base as possible. Independence was not a basis for selection. Panel members "are expected to represent their individual scientific judgements and not act as representatives of technical positions taken by their organizations." This may be difficult, since panel members were likely to have contributed to the technical positions taken by their organizations. The group also has 10 members, much larger than may be optimal. The assembly of this group was an interesting contrast to the CNWRA expert elicitation, in which many pains were taken to assure independence and to avoid bias. The authors appeared to concede that the topic was controversial and that future analysis would entail expert elicitation, logic tree analysis, and aggregation of hazard results.

IMPRESSIONS AND CONCLUSIONS:

- Again this year, there was considerable interest in the MPC design, materials selection and testing, transportation, and licensing. Presentations in various technical sessions included all aspects of the concept, including materials selection, heat loading (related to burnup credit), design/welding, interim storage, transportation, and details of materials testing programs schedules. The award of a contract by the M&O/TRW for the study of MPC design to a team consisting of Westinghouse, Packaging Technology, and Chem-Nuclear was announced.
- There appears to be increased interest and technical activities related to the disposal of plutonium from nuclear weapons. A number of national labs are currently involved in the DOE program, with Lawrence Livermore National Lab being one of the leaders.
- Attendance at two QA sessions indicated some level of disarray in DOE's QA program across its contractors. Examples of problems included computer code configuration control for scientific codes - shades of TOP-018.
- In the session on Expert Judgment, Geomatrix presented the protocol they used for the current volcanism elicitation which brought many questions from the audience especially about the nomination and selection process for their panel. It is clear that there is still significant interest in the EJ subject in the HLW area.
- While there was a modest amount of interest in the Regulatory Program Database\Open Item Tracking System's (RPD\OITS) capability, there were many more questions and inquiries into the content and access to OITS from DOE personnel and their contractors. These inquiries were referred to the NRC.
- Substantially lower attendance (25% drop) at the meeting this year was attributed to late and reduced support from the DOE-OCRWM for participation at the conference. Many attendees did not like the new format of printing only 3-page abstracts because in the past they have been able to use the information from the full-length papers as a valuable information resource for many years after the meeting. This criticism was discussed at the program planning committee meeting for the next year's conference, however, no change from the current abstract-only format is planned for the next year.

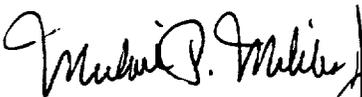
PENDING ACTIONS: None.

RECOMMENDATIONS: None.

PROBLEMS ENCOUNTERED: None.

REFERENCES: None.

SIGNATURES:



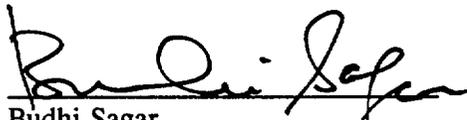
Michael P. Miklas, Jr.
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Budhi Sagar
Technical Director

7/2/95
Date