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CENTER FOR NUCLEAR WASTE REGULATORY ANALYSES

TRIP REPORT

SUBJECT: Attendance at Waste Management '01
20.01402.951, 952, 953, and 761

DATE/PLACE: February 26–March 1, 2001, Tucson, Arizona

AUTHORS: P. Mackin, G. Wittmeyer, and S. Mohanty

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PERSONS PRESENT: Authors and approximately 2,100 conference participants. Nearly 500 papers were presented.

BACKGROUND AND PURPOSE OF TRIP:

The authors attended the Waste Management 2001 (WM '01) conference as session chairs, co-chairs, and presenters. The waste management series of annual conferences addresses broad concerns in areas related to management and disposal of radioactive waste.

SUMMARY OF PERTINENT POINTS:

Not applicable.

SUMMARY OF ACTIVITIES:

The authors attended a variety of the presentations during the course of WM '01. The following paragraphs summarize key points from individual sessions.

G. Wittmeyer co-chaired a poster session titled Environmental Remediation.

S Mohanty of the Center for Nuclear Waste Regulatory Commission (CNWRA), B. Vigreux (formerly with COGEMA), and T. McCartin of the U.S. Nuclear Regulatory Commission (NRC) organized and chaired a three and one half hour session on Integrated Performance Assessments of Wastes Disposal Systems. This session focused on interdisciplinary studies involving engineering, geosciences, and health sciences. The topics emphasized challenges in developing a multidisciplinary process that includes researchers from scientific disciplines that have not traditionally worked closely together. This session addressed low, intermediate, and HLW disposal systems and stood in contrast with the special session focused on the siting of a high-level waste (HLW) repository at Yucca Mountain (YM). Attendance ranged from 16 to 46 with approximately 45 attendees until the middle of the session and was viewed by the conference organizers as a successful

session with a significant improvement in audience interest from last year when it was first introduced. The session was successful in bringing together practitioners of integrated approaches in the high-level, low-level, and other waste disposal industries from various countries to discuss implementation experiences.

P. Mackin presented a poster titled Implementing Risk-Informed and Performance-Based Regulations for High-Level Waste Disposal. This poster was co-authored with J. Ciocco, D. Turner, and B. Russell. The poster emphasized the ways in which risk-informed, performance-based considerations are being incorporated in the Yucca Mountain Review Plan.

Professor B. Cohen of the University of Pittsburgh, presented a paper titled How to Do a Probabilistic Risk Assessment (PRA) for a High-Level Waste Repository that the Public Can Understand and Accept. Dr. Cohen proposed that the measure of performance be estimated deaths. He stated that this measure would allow comparison of risk from HLW with risk from other technologies and would promote rational decision making and public understanding. He stated that this approach is used for reactor safety and has increasing use in other industries. Dr. Cohen noted specific problems with the HLW PRA, specifically that whereas reactor PRAs have been done for 40 yr and the various aspects are well understood, geological information required for a PRA for a HLW repository is difficult and expensive to obtain. He cited as an example the PRA that supports the U.S. Department of Energy (DOE) viability assessment for YM and noted that it contains 177 variables, each with its own probability distribution function. This situation promotes scientific disagreement on the variables. For his alternative approach, Dr. Cohen proposed that a PRA be conducted for an "average" U.S. site, with the properties selected as U.S. average values. This approach would avoid site-specific concerns, and Dr. Cohen stated that changes in U.S. average parameters would be significantly smaller than changes that might occur at a specific site. He also claimed that this approach would be easy to understand and would have little uncertainty. Dr. Cohen stated that acceptance of his approach would require a "leap of faith" that an expertly selected site would be at least as safe as one based on average U.S. parameter values. Dr. Cohen believes that this PRA should be more acceptable than a complex YM analysis that has substantial uncertainties. Dr. Cohen stated that the results of his average U.S. site PRA were .02 eventual deaths over millions of years, and he compared these with annual deaths from the coal industry of 25 per year from air pollution and 30 per year from carcinogenic chemicals. Dr. Cohen also proposed that we discount for future effects, similar to the way we discount for monetary values. For example, he noted that the cancer survival rate is improving and that we might consider using a trust fund approach where future generations would know better how to spend funds to address specific concerns than we can today. Dr. Cohen expressed a willingness to discuss the details of his PRA with any interested persons.

B. Cook, Manager, DOE Idaho Operations Office, made a presentation entitled Learning to Program Your VCR and INEEL Technology Deployment Challenges. This presentation addressed the various ways in which we have employed or accepted new technologies. These ways included full immersion, ignoring technology, and all points in between. The presentation stressed the need to plan for change as technologies evolve and to use judgment in assessing which evolving technologies are not needed for a specific project.

Four DOE staff made a presentation titled Yucca Mountain Project: Science and Engineering Status. The first presenter was S. Brocoum. He discussed the overall status of the YM project including milestones for the repository program, the site recommendation process, and the technical basis that will be used for any site recommendation. He also provided the status of the regulatory framework, the site recommendation, and the environmental impact statement (EIS) which will accompany any site recommendation. Mr. Brocoum's presentation included a description of the work that will support the technical basis for the site

recommendation and a discussion of the remaining site characterization work. This remaining site characterization work is related to (i) quantification of uncertainties in total system performance assessment (TSPA) process models and model abstractions, (ii) understanding fundamental processes including waste package corrosion, (iii) evaluation of a design over a range of operating temperatures, and (iv) development of multiple lines of evidence and argument for a safety case. The results of this site characterization activity will be included in the technical basis for any site recommendation. The next presenter was M. Peters, Manager, Science and Engineering Testing, at Los Alamos National Laboratory. He addressed the highlights of scientific testing for YM. His paper included (i) the drift-scale test being conducted for the unsaturated zone; (ii) cross-drift studies, including in Alcove 8, Niche 3, and bulkhead investigations; (iii) the Busted Butte unsaturated zone transport test; (iv) the cooperative studies with the Nye County Early Warning Drilling Program and the Alluvial Testing Complex; and (v) the engineered barrier system ventilation testing and waste package materials testing. This testing is all designed to address key processes and related uncertainties in natural and engineered systems. The results from these investigations will be incorporated in any site recommendation, as appropriate. The third DOE presenter was P. Harrington, Acting Deputy Assistant Manager, Office of Project Execution, of the YM Site Characterization Office. He discussed the evolution of repository design. This presentation focused on the need to provide flexible repository design objectives to accommodate future policy decisions, alternative technical objectives, and new information. These flexible design objectives are also to allow consideration of a range of repository temperatures. Mr. Harrington compared the design features that were presented in the viability assessment, enhanced design alternative II, and the current reference design and operating mode for both high and low temperatures. He also addressed many factors that determine the most appropriate operating temperature. His presentation included an expanded subsurface repository layout that would accommodate a low temperature operating selection and an expanded ventilation system. Future design activities were to be a complete thermal design analysis, a review of the invert design to improve diffusive barrier performance, and evaluation of postclosure and preclosure performance. The final presenter was Dr. A. Van Luik. His presentation included a demonstration of a CD ROM that is being made available to describe the YM performance assessment (PA). This CD appears to be an attempt at public outreach and it is planned for continued revision to support understanding by high school students. The author requested a copy of this CD from Dr. Van Luik.

A.M. Huffert of the NRC, Office of Nuclear Material Safety and Safeguards (NMSS) made a presentation titled Status of NRC Efforts on Regulatory Approaches for Control of Solid Materials. Mr. Huffert's presentation addressed the question of whether solid material with small levels of activity must be sent to a disposal facility or can be recycled. He described the current process for dealing with these questions. Since there is no existing standard, and more licensees are trying to release such materials, the NRC is currently making determinations on a case-by-case basis. While this approach is adequate, the lack of formal criteria could lead to inconsistency in regulatory decision making. Mr. Huffert described the series of NRC actions that have sought input on this question. He then described the alternatives which are (i) no rulemaking, continue the current practice or update guidance; and (ii) conduct a rulemaking. This rulemaking might take three approaches. One approach would be to define an acceptable dose or contamination level. The second approach would establish restrictions limiting release, and the third option would be to prohibit such release. Mr. Huffert described stakeholder reactions by summarizing their comments. The presentation ended with a description of future NRC actions. The National Academy of Sciences, at Commission direction, is studying the alternatives. The NRC staff is developing technical bases, and a decision on whether to conduct a rulemaking will eventually be made.

A. Wallo, H. Peterson, and E. Regnier of DOE had a paper titled Revised Requirements for Recycling Metal at USDOE. This paper discussed the results from a January 2000 Secretary of Energy moratorium on release of volumetrically contaminated metals from DOE sites and the establishment of a task force to examine and make recommendations regarding this problem. The presenter noted that the priority for resolution of this problem is increasing as sites are cleaned up and made ready for closure. The task force found that most of the material in question is not contaminated or has contamination below limits. However, it also found opportunities for improvement in dealing with this material. In July 2000, the Secretary of Energy suspended unrestricted release for recycling of any volumetrically contaminated materials from radiation areas. The Secretary also directed that improved release criteria and practices be established, that recycling be promoted within the DOE complex, and that improvements in the inventory of these materials be made. The presentation outlined proposed procedures for dealing with this material. First, the material must be surveyed and residual radiation must not be detectable. Second, if residual radiation is detected, it must be removed. Third, any such residual radioactive material must be disposed in a low-level waste (LLW) disposal site or a landfill facility designed for such materials. Last, criteria will be established for release for restricted recycling, and implementation guidance for measurement and statistical analysis will be developed. DOE has received comments on these proposals that are similar to those received by NRC on its approaches for control of solid materials. DOE has decided to prepare an EIS dealing with this issue.

O. Emond, M. Klein, and Y. Demeulemeester from SCK-CEN of Belgium, presented a paper titled The Management Routes for Contaminated Metals from Dismantling of Nuclear Reactors. This paper documented the experience to date for dissembling and decontaminating materials from a pressurized water reactor. The process is to be completed by 2005. During dismantling, three categories of materials were established: noncontaminated, radioactive waste, and materials that could be recycled. During dismantling, the large pieces were cut, sorted, and identified and placed in a temporary storage location. From there, batches of similar materials were created, with each batch being uniquely labeled and with strict accountability being provided in a database. Materials that were contaminated were then processed in a low-activity waste processing facility. In this facility, treatment methods included super-compacting and cementation. The decontamination techniques applied included simple washing, decontamination with a wet abrasive, and decontamination with chemicals. Where appropriate, materials were melted for recycling. During the melting, cesium-137 was volatilized. Measurement techniques used to assess radiation levels included hand-held devices, spectrometers, and gross-gamma measurement equipment. So far, this process has resulted in a waste reduction of approximately 95 percent.

N. Brown and D. Parkinson of Integrated Water Resources, Inc., and J. Dablow of IT Corporation, prepared a paper titled Dynamic Underground Stripping and Hydrous Pyrolysis/Oxidation of PCE and TCE at Savannah Site. This paper discussed the process by which PCE and TCE are being removed from a contaminated site. Progress is being monitored using electrical resistance tomography and thermocouple arrays to show the extent to which the underground temperature has been raised by piping steam into the subsurface. This process seemed to be very much like steam injection vapor extraction processes investigated at the CNWRA. The presenter noted that it was not necessary for everything in the underground to reach boiling temperature: just to get PCE and TCE at a temperature where they can be mobilized and volatilized. Using this process, approximately 15,500 lb of PCE and 1,300 lb of TCE have been removed from the site. These chemicals are extracted and concentrated using equipment at the surface.

Several individuals from Integrated Environmental Technologies, LLC; MSE-Technology Applications, Inc.; Los Alamos National Laboratory; and Earth and Environmental, Inc. prepared a paper titled Results from the Nontraditional (Subsurface) *In Situ* Vitrification Demonstration for Mixed-Waste Applications at the Los Alamos National Laboratory. This paper discussed the electrical melting and subsequent fusing in a glass-like form of contaminated soils and waste in a demonstration of the process at Los Alamos National Laboratory. The process uses temperatures from 1,400–2,000 °C and results in solidification of approximately 100 tons of material per day. The process is applicable to all contaminant types and concentrations and has a high tolerance for debris. The presenters claimed that the vitrified product is approximately 10 times stronger than concrete and 100 times more durable than HLW glass. They likened the product to volcanic rock. The process uses as heating elements, vertically oriented planer melters that result in subsurface melts that grow and merge with a resulting low heat loss. The process also requires offgas treatment for materials that are volatilized. This is usually accomplished within a hood placed over the area where the heating is done. The presenters claimed that this process had greater energy efficiency than similar processes attempted previously and results in no emissions or particulate releases.

R. Tomlinson, of ITRC/ECOS and M. Yelkin, of the Western Governors Association prepared a paper titled Reducing Regulatory Barriers to Technology Development. This presentation addressed an organization formed by a group of Western governors and federal agencies to achieve better environmental protection through innovative technologies. The group strives to reduce technological and regulatory barriers and to build confidence in using new technologies. It also works to improve permitting processes and to speed up the application of new technologies. DOE and the U.S. Environmental Protection Agency (EPA) are members of this organization.

Contributors from RedZone Robotics, Inc. and DRS/LLC prepared a Case Study of Robotic Dismantling of Building K-1420 Area B Uranium Recovery Area. This presentation described the use of a machine called ROSIE for the remote dismantling and removal of piping networks and internal structure for a contaminated building so that the building could eventually be reoccupied. The robot used cameras and remote controls, and the presentation consisted primarily of a discussion of machine operations.

Contributors from PNNL, Glass Service, The Institute of Chemical Technology, and the Czech Academy of Sciences prepared a paper entitled Increasing High-Level Waste Loading in Glass without Changing the Baseline Melter Technology. This presentation examined whether HLW loading could be increased by developing a mathematical model through laboratory experimentation to examine the processes involved. The presenter claimed that increasing waste loading by 1 percent for the Hanford facility would save one billion dollars in vitrification cost. The basic question was whether temperature could be increased without putting the melter at risk by causing rapid growth of a sludge layer. The presenters found that spinel is the most common crystal formed in melters and can interfere with the melter by enhancing sludge formation. They also found that adding minor impurities can lead to more and smaller spinel crystals. Their investigation showed that the equilibrium volume fraction of crystals and the crystal number density are functions of temperature and glass composition and that the growth rate of sludge is a function of spinel crystal size. Their experiments led to the conclusion that small spinel crystal size reduces the growth of the sludge layer, and they measured a variety of parameters to support use of a mathematical model of sludge growth. The experimenters found that crystal size can be reduced by increasing the crystal number density by adding nucleation sites. Their conclusion was that increased waste loading can be achieved with current melter technology.

Contributors from CEA/CALRHO, COGEMA, and SGN presented a paper titled, The Cold Crucible Melter, a Key Technology for the DOE Cleanup Effort. This paper discussed and compared the cold crucible melter technology to the melter technology used in most other facilities. The presenter cited COGEMA experience in producing 10,000 waste canisters incorporating 3.5 billion curies and resulting in 4,000 tons of HLW glass. The cold crucible melter makes use of direct high-frequency induction in a water-cooled stainless steel container. The technology results in the formation of a frozen glass layer next to the crucible surface which protects the crucible. The glass is mechanically stirred when it is melted, promoting homogeneity and inhibiting settling and sludge. Its applicability to HLW vitrification was examined using a low-activity waste surrogate and varying factors such as the size of the glass warmer, feeding methods, glass-forming chemicals, and temperature. The HLW surrogate testing resulted in an increased waste loading of from 25–75 percent. The presenters claimed that use of cold crucible technology could result in 128 million dollars in capital savings and 2.4 billion dollars in life-cycle cost savings.

R. Palmer and S. Barnes of West Valley Nuclear Services Company and W. Hamel, Jr., of DOE prepared a paper titled, West Valley Demonstration Project: Vitrification Campaign Summary and Path Forward to Melter Shutdown. This paper discussed criteria used to vitrify HLW from the West Valley tanks. It included a definition of the waste-form qualification process, which required waste acceptance product specifications, a waste-form compliance plan, a waste-form qualification report, production records, and storage and shipping records. There were separate specifications for the glass product. The specifications addressed chemistry, radionuclide inventory, product consistency, phase stability, hazardous waste, and International Atomic Energy Agency safeguards requirements. There were also specifications for the canisters which included their material, fabrication and closure, identification and labeling, and dimensions. In addition, there were specific criteria for the waste form and these criteria were related to expectations for a repository design. Initially, canisters were being produced at West Valley at the rate of 2–3 per week. Because most of the waste has been vitrified and the tanks are being flushed to cleaner and cleaner levels, there is now approximately one canister per month being produced. There is no laboratory facility at the West Valley site to conduct a product consistency test; therefore, a numerical model is being used for this purpose. To date, the West Valley Demonstration Project has produced 255 waste canisters that incorporate 11.7 million curies.

W. Hamel, Jr. of DOE and F. Damerow of West Valley Nuclear Services Company developed a paper entitled Completing HLW Vitrification at the West Valley Demonstration Project; The Approach to Final Retrieval, Flushing, and Characterization. This paper discussed the path forward at the West Valley site once vitrification of the HLW is completed. It addressed the process for determining which materials will be HLW and which will be incidental waste. The presentation discussed treating components used to process the HLW such as piping, tanks, and the vitrification melter. The first step in the process will be to finish zeolite retrieval from the 8D-1 HLW tank. The second step will be to complete Purex waste removal from the 8D-2 HLW tank. Then, the transfer lines will be flushed followed by a flush of the vitrification vessel using glass former. A problem has been discovered with the HLW tanks in that unexpectedly high beta and gamma radiation levels were found on the upper levels of the walls of the tanks. It is suspected that this radiation is coming from cesium, strontium, and possibly curium. The theory is that some years ago, when liquid wastes were being evaporated in the tanks, the sides of the tanks became contaminated with these radionuclides as the liquid waste level dropped. The presenter stated that the most difficult incidental waste criterion to meet is expected to be the one requiring that the waste be able to be classified as Class C. The presenter stated his opinion that spray lancing of the interior of the tanks is likely to be insufficient to reach the Class C level.

M. Downing of DOE and M. Hudson of SAIC prepared a paper titled Community Capacity Building. This paper addressed issues of environmental justice and described a program sponsored by DOE to involve stakeholders more directly in planning and decision making as they relate to environmental justice issues. Community capacity building refers to giving communities the tools to participate effectively in the decision making process. The DOE program provides access to computers, training, and technical assistance for these communities. The DOE program also has established demonstration projects in the form of community technology centers that have been established at Savannah, Georgia, and Fort Belnap Indian Reservation. The organization has also formed a partnership with the National Conference of Black Mayors.

N. Ishiyama of Rutgers University and K. Tall Bear of IIIRM prepared a paper titled, Changing Notions of Environmental Justice in the Decision to Host a Nuclear Fuel Storage Facility on the Skull Valley Goshute Reservation. This presentation provided insights on the Goshute Tribe concerns with respect to environmental justice for the storage facility proposed for their reservation. The presentation noted that there is a regional history of environmental contamination that forms a backdrop for decision making on this project. This contamination comes from biological and chemical weapons activities and mill tailings. Native Americans in the area feel that they have been excluded from previous decision making on these matters and that there is a history of neglecting the interests of the affected communities. The State government also feels that it has been kept out of environmental decision making. The author noted that environmental justice is more than the consideration of the distribution of hazards. It is also procedural justice and the redistribution of power: focusing on location of facilities is not enough. She noted that tribes are not monolithic in their opinions about the siting of these facilities, and tribal sovereignty and self-determination are necessary aspects of dealing with environmental justice issues. She also noted that there are intra-tribal politics that reflect differing opinions of Native Americans and that stereotypes of the Native Americans have adversely affected their tribal sovereignty. In conclusion, the author stated that environmental justice means decision making considering costs and benefits, not only minimizing risk load. In other words, Native Americans may deliberately choose to accept the siting of a facility, and their decision making rights should be recognized.

M. Scott of PNNL presented a paper titled Implementing Environmental Justice in Environmental Impact Statements. The point of this paper was that environmental justice concerns are not a set of new requirements related to EISs. Rather, Council on Environmental Quality regulations and guidance require that disproportionate health and environmental impacts of all kinds be examined in EISs.

A. Thrower and W. Portner of SAIC and J. Holm of DOE prepared a paper titled Property Valuation and Radioactive Materials Transportation: Reflections 12 Years After City of Santa Fe v. Komis. This paper reviewed the effects of the development of a "WIPP relief route" near the city of Santa Fe. The issues concerned the potential devaluation of property along this route from the transportation of radioactive waste. The State of New Mexico was sued for "taking" the land necessary to build this road. One question was whether the State had the right to effect this taking of land. Under the courts, it was ruled that it was legal because, under Department of Transportation regulations, states or localities can identify alternative routes for the transport of hazardous material. The court case dealt with the fear that the public had about transportation of radioactive materials. The case is the only one so far where people have recovered value for property devaluation from radioactive waste transportation. The judge ruled that the fact that transportation was safe was not the issue. The issue was the fear from the perception of the public along the route. The presenter noted that other societal benefit cases did not result in compensation to those who were harmed by the action. When courts award compensation, they are guessing what the eventual harm or outcome is, and the results are only determined after the fact. Twelve years after building of the WIPP relief

route, the author examined what the effect has been. In fact, there is substantial new construction of residences and businesses along this route. There is also heavy truck traffic on the route, and additional development is being planned. The road has now been designated as "Veterans Memorial Highway," and land along the route is selling for $150,000 per acre for unimproved lots. Therefore, the conclusion is that so far the fear factor has not resulted in a failure to develop the property along this road.

W. Falck of IAEA presented a paper titled, Nontechnical Factors Influencing the Decision Making Processes in Environmental Remediation Projects. This paper addressed environmental remediation in countries other than the United States. The author discussed societal goals and added values of projects including sustainability, employment, development of the skill base, and future land use. He also addressed the social implications of environmental remediation projects including perception of the stakeholders, effects on social identity, and on how culture effects communication of issues. The author then described the implementation risks of environmental remediation including results from the stringency of cleanup standards, problems with competing regulations, costs, the availability of resources, the risks associated with the remediation technology, the ultimate environmental impact, and issues related to residual wastes. The author noted that remediation objectives should be defined before starting and should be aimed at reducing exposures and minimizing impacts, as well as ultimately adding value to land and the community. The presenter noted that other countries are generally not as advanced in conducting remediation as we are in the United States.

S. Hernandez and M. Clark from EPA and M. Nelson from Northern Arizona University prepared a paper titled Bridging Indigenous and Traditional Scientific Approaches: Illustrations from Two Projects. This paper dealt with problems caused by a legacy of nuclear waste buildup, its impact on Native Americans, and their resultant distrust of scientific studies and government. The presenter noted that affected lands are often both remote and strategically important. The first project addressed Navajo concerns, which are abandoned mines, use of mine wastes for construction, and lung disease and cancer in mine workers. In response, the Uranium and Radiation Education Project has been established to educate students and teachers. This project also forms partnerships with communities and involves the Northern Arizona University and Dine College. The other group addressed in the paper is Alaskan Native Americans. Their concerns are the results of nuclear testing in the Aleutians and the military bases there, environmental change, the potential for contamination from disposal of Russian submarine reactor cores in the oceans, and distrust of science. In response, the Alaska Traditional Knowledge Project has been established to aide communities in identifying and answering questions, to document traditional and scientific knowledge, and to foster community involvement. This project is also linked to the University of Alaska and the Alaska Nature Science Commission. Both these programs attempt to integrate tribal and scientific methods. Their guiding principles include the use of inclusive science, which examines the full range of approaches and disciplines; the community's right to know; and stewardship of the land and resources. The approaches and techniques used for each of these projects are being designed to be culturally appropriate for the individuals affected.

J. Peterson of the University of Tennessee presented a paper titled The American Chemical Society's Division of Nuclear Chemistry and Technology's Summer Schools in Nuclear and Radio Chemistry. This presentation discussed an advanced undergraduate fellowship program that is available through the American Chemical Society and that provides opportunities to learn about nuclear science from practitioners. The fellowship encourages a career in some aspect of nuclear science. The presentation included the history of this program.

S. Pulsford of Bechtel National, Inc.; J. Clodious of Brookhaven Science Associates; C. Newson of LVS Inc.; and J. Penny of DOE prepared a paper titled Public Decision Process for End-State Determination for the Brookhaven Graphite Research Reactor Decommissioning Project. This presentation discussed the manner in which public input is being incorporated into this decommissioning project. The alternatives screening for the decommissioning was studied and public comment was obtained. The alternatives are now being further studied considering the public comments, and the results will again be submitted for comment. The alternatives screening used CERCLA and NEPA criteria. A working group was established with a broad membership and meets monthly. The general approach is to proceed with small actions while making the decisions on the larger or more complex actions in parallel.

W. Goldston, E. Wilhite, and H. Villasor of WSRC; and V. Sauls of DOE prepared a presentation titled Stakeholder Interaction and Cost Savings: Low-Level Waste Disposal in Trenches Versus Vaults. This paper discussed how the Savannah River site changed a recommended disposal method twice within 10 yr with concurrence from the associated citizens' advisory board. Through 1999 there had been an agreement that the only environmentally acceptable disposal for LLW was in above-ground vaults. The citizens advisory board concurred in this agreement. The operators of the site found out that over 70 percent of the space in their vault was being used to emplace slightly contaminated soils but that the 70 percent of the vault volume included only 30 percent of the activity. Therefore, the site operators did a second PA which demonstrated that the slightly contaminated soils could be safely disposed in the trenches and that, by using super-compaction techniques, the other wastes could be disposed in the above-ground vault. This could save substantial money over the course of the project. The PA was the foundation for the determination that the soils could be disposed in the trenches. The citizens' advisory board did not believe this result, so the site operators took several steps to gain their concurrence. First, they obtained approval and concurrence from the State and national regulators. Then, they briefed the citizens' advisory board on the way in which the PA was done. They started at a summary level and then went into as much detail as was required by the members of the citizens' advisory board. They also brought into play the cost considerations. They used a systems approach to show how various aspects of the disposal interacted. They designed their briefings to the understanding level of the citizens' advisory board members, and they brought the advisory board into the process early. They were frank about how the PA was conducted, and they included a peer review of the results.

P. Wagner and J. Doering of Fluor Fernald, Inc. presented a paper titled Tackling DOE Site Future Use Through Public Participation. This presentation focused on the way in which public participation is brought to bear to support cleanup of the Fernald, Ohio, site. The presenter noted that it was necessary to start early with public participation. This approach recognized that site cleanup is a long process and that it is necessary to have wide involvement and to build consensus. Bringing more people into the process ultimately means better decision making. It was necessary, at the start, to establish ground rules for the public participation process. The presenter then discussed that management support is essential to the success of an activity such as this and that it is necessary to identify internal and external lead organizations. The author then stressed the necessity to attract a diverse set of stakeholders and to recognize that, since the cleanup process will take a long time, there will be stakeholder attrition. Participants should expect that with each new stakeholder, there will be new issues and new ideas that need to be accommodated in the process. Some tools recommended for use by the presenter included person-to-person contact, which he felt was the most important; use of envoys for specific issues; education and outreach programs for the local community; interactions with the media; and use of the Internet and workshops to spread information about the project.

The presenter ended by stressing that once the activity starts, it should be continued until completion and that the momentum established should be built upon to save time and money.

D. Orlando, L. Camper, J. Buckley, W. Ripley, and R. Dudley of NRC prepared a paper titled Status of the NRC's Decommissioning Program. This presentation included an explanation of the basis for and differences between restricted and unrestricted release. The presentation reviewed the history of the regulatory framework for decommissioning. It also discussed program integration within NRC among NMSS, Office of Nuclear Reactor Regulation, and Office of Nuclear Regulatory Research. The presenter noted that decommissioning activities are tracked at a high level in the agency operating plan and that a decommissioning managing board is now meeting to assist in oversight for the program. The presenter also noted that NMSS assumes responsibility for reactors when the fuel leaves the fuel pool. NMSS is also responsible for confirmatory surveys, reviewing cost estimates, reviewing license termination plans, and conducting licensing for independent spent fuel storage installations. The presenter gave a summary of the site decommissioning and management plan (SDMP) program. He noted that current criteria for being placed on the SDMP include that a site be proposed for restricted release or that it be a complex unrestricted release site. These sites tend to be those that require site-specific dose modeling, that have heightened public interest, or that have questionable finances. The presenter covered the development and purposes of recently prepared decommissioning regulatory guidance. He also discussed public outreach programs being implemented within the decommissioning portion of the staff including the use of workshops and communication plans. The presenter stated the future challenges for the decommissioning program to include issues related to partial site release, consolidation of regulatory guidance, the process for long-term stewardship for restricted release sites, and decommissioning process improvements.

R. Nelson and C. Pittiglio of NRC prepared a paper titled License Termination Process for Nuclear Power Reactors. This presentation began with a description and discussion of the relevant regulations and regulatory guidance and then described the submissions that are required from a power plant entering the decommissioning phase. These include a verification of the cessation of reactor operations and a confirmation that fuel has been removed from the reactor. Another required submission is the postshutdown decommissioning activities report, which describes the planned decommissioning activities and their schedule, cost, and rationale. Licensees are also required to submit a license termination plan within 2 yr of the expected termination date. The license termination plan includes a site characterization, discussion of dismantlement activities, a cost estimate, plans for final survey, and special considerations for any restricted use. It may also include any need to develop an EIS supplement. Licensees are also required to submit a final survey report that demonstrates compliance with release criteria and with the survey plan. Three specific issues are identified for reactor decommissioning. First, site-specific dose modeling requires more information and time for review. Second, presubmittal conferences often result in greater efficiency and effectiveness of reviews by the staff. The final issue was the realization that there are inconsistent federal agency approaches to decommissioning. Several lessons learned were pointed out by the presenter:

- Early and frequent consultations between the licensee and the NRC are helpful
- Operational and environmental monitoring of groundwater may be inadequate for site characterization; site characterization requires information about stratigraphy, groundwater movement, and geochemistry
- The design of the final survey must involve the application of appropriate data quality objectives

- In-process inspections are more efficient than a one-time confirmatory survey
- Continuous dialogue with the staff is needed so that a licensee can make use of the flexibility in MARSSIM
- Derivation of cleanup levels should include assumptions and justifications for the parameters used
- There should be a clear relationship between the planned decontamination activities and the cost estimate
- Old records are often inadequate or inaccurate
- Environmental impact reviews need to consider nonradiological impacts

J. Burclova and L. Conecn of the Nuclear Regulatory Authority of the Slovak Republic prepared a paper titled Nuclear Regulatory Authority Requirements—First Phase of NPP A1 Decommissioning. The presentation discussed the difficult decommissioning activities at a reactor in the Slovak Republic where preshutdown accidents had caused extensive decontamination. These accidents included the ejection of a fuel assembly into the reactor hall and use of a nonconforming fuel assembly that caused fuel damage. The facility did not have decontamination and storage facilities, and a systematic plan for decommissioning did not exist. The accidents had caused cladding damage and primary-to-secondary contamination and led to a decision not to restart the reactor. However, the most challenging problem in the decommissioning was spent fuel management. Initial plans were to store the fuel for only 3 yr, but the final fuel assemblies were not removed until 22 yr from the start of fuel storage. As a result, there was extensive fuel cladding damage, spent fuel damage, and coolant and systems contamination. From 1980 to 1995 was a period referred to as the nonsystematic decommissioning period. Following that, having learned many lessons, the facility began using a more systematic decommissioning program. However, the activity was hampered in that there were no regulations or funds for decommissioning.

P. Woollam of BNFL Magnox Electric PLC presented a paper titled Reactor Decommissioning Strategy: A New Start for BNFL. This paper discussed the need for BNFL to shut down all its reactors by 2009. BNFL owns 26 units on 11 sites. Eight are now permanently shut down, but the rest will need to be shut down by 2009. There will be large and complex on-site decommissioning efforts because of the size of the components. The fuel will be reprocessed at Sellafield. There will be no on-site fuel storage. No disposal means exist for the activated decommissioning waste, and there is no geologic repository facility planned for as long as 100 yr. There are also no provisions for license termination, although it is likely that the European Union basic safety standards will be used. These standards require cleanup to 1 mrem/yr. Principles at BNFL that will apply to the reactor decommissioning include the following:

- The strategy will be based on the dominant isotopes and half-lives in various places in the systems.
- Reactor buildings will be weather proofed and made intruder proof, and there will be no permanent manned security. However, there will be routine inspections monitoring and maintenance.

- It is planned that the reactors will all be dismantled in approximately 100 yr.

M. Duffy and P. Esmailzadeh of Battel Memorial Institute prepared a paper titled A Systems Engineering Approach to Establishing a D&D Baseline. This paper described response to a DOE request for a baseline cost and schedule for completing a D&D that was suitable for independent evaluation. The objectives of establishing the baselines were to have a process that was defensible, logical, and comprehensive and to have outcomes that defined the necessary work and considered all the alternatives. There was also a need to trace cost estimates to activities. The overall approach included conducting working sessions with subject-matter experts; completing data templates that contained the necessary information to establish the baselines; establishing work scope baselines, schedule baselines, and cost baselines; and then providing a baseline summary. The effort was supported by a functional analysis, which started with the mission and then a decomposition of the mission into essential functions. Functions represent what is to be accomplished. Specific requirements were defined for each function. These requirements defined how well the functions must be performed. Finally, an architecture was selected to support the requirements, which specified how each item was to be accomplished. The functional hierarchy was broken down to a level at which the subject-matter experts agreed that they could estimate costs. The process sought to maximize safety and to minimize cost, schedule, and risk. It relied extensively on relevant experience and expert judgment. Independent project reviews were also employed.

D. Esh and R. Codell of NRC presented a paper titled Quantification of the Sensitivity of Repository Performance to Subsystem Variability. In this paper the authors recognized that identifying the subsystems that contribute to uncertainty in the risk metric is one task in implementing risk-informed regulation in HLW disposal. Results from the latest version of the Total-system Performance Assessment 4.0 code, were used to explore the contribution of uncertainty in a single input variable, subsystem, or system when comparing the nominal case with the case in which the variable or group of variables is held at mean values. The authors used the expected (i.e., mean) dose to the average member of the critical group to demonstrate compliance. The following metrics were examined for sensitivity in comparing the output distributions: (i) the difference between the means of the output distributions, (ii) differences between the variances, (iii) the Kolmogorov-Smirnov test, and (iv) a variation of the Kolmogorov-Smirnov test based on the area between two cumulative distributions. The last technique appears to have the best power to resolve system- and parameter-level sensitivity. Since this approach requires one or more large sets of Monte Carlo calculations for each system or variable tested, computational requirements are large. The results from the analyses for the nominal scenario identified the systems or parameters likely to contribute to uncertainty in estimates of risk for the proposed repository. These subsystems in order of importance were (i) degradation of the engineered barrier system, (ii) the exposure pathways (biosphere), (iii) the quantity and chemistry of water contacting the waste packages and waste forms, (iv) radionuclide transport in the saturated zone, (v) radionuclide release and solubility limits, (vi) flow paths in the saturated zone, and (vii) well pumping.

J. Cochran of Sandia National Laboratories and others presented a paper titled Results of the Performance Assessment for the Classified Transuranic Wastes Disposed at the Nevada Test Site. This paper provided an overview of the Greater Confinement Disposal (GCD) disposal system and the associated PA. Most transuranic (TRU) wastes are to be disposed at the Waste Isolation Pilot Plant (WIPP). However, the TRU wastes from the cleanup of U.S. nuclear weapons testing are classified for national security reasons and cannot be disposed at WIPP. The DOE sought an alternative disposal method for these "special case" TRU wastes, and from 1984 and 1987, four Greater Confinement Disposal (GCD) boreholes were used to place these special case TRU wastes a minimum of 21 m (70 ft) below the land surface and a minimum of 200 m

(650 ft) above the water table. The GCD boreholes are located in arid alluvium at the Nevada Test Site (NTS). Because of State regulatory concerns, the GCD boreholes have not been used for waste disposal since 1989. The DOE Nevada Operations Office contracted with Sandia National Laboratories to conduct a PA to determine if the TRU waste emplaced in the GCD boreholes complies with EPA requirements for disposal of TRU waste in 40 CFR Part 191. This EPA standard establishes probabilistic limits on the cumulative releases of radionuclides to the accessible environment for 10,000 yr. From results of the PA, the authors showed that disposal of TRU wastes in the GCD boreholes complies with 40 CFR Part 191 standards with a large margin. The final PA documents will be released in FY2001 or FY2002.

S. Mohanty, B. Sagar, M. Miklas, and R. Folck of CNWRA prepared a paper titled Transparency and Traceability in Performance Assessment of High-level Nuclear Waste Repositories. The paper highlighted that any complex calculation requires transparency and traceability for presentation to stakeholders. The preclosure and postclosure safety cases [preclosure safety analysis (PSA) and PA, respectively] for HLW repositories rely to a significant extent on complicated analyses based on mathematical models and use a large amount of data. A PSA and a PA contain system descriptions and supporting databases, scenario analyses, consequence analyses, performance measure calculations, sensitivity and uncertainty analyses, and a comparison of estimated performance to regulatory requirements. For a regulator to evaluate compliance, the applicant is expected to provide sufficient information in a license application for the regulator to adequately understand and evaluate the approach and results. Transparency and traceability in the PSA and PA are necessary for the regulator to determine whether or not the regulatory requirements will be complied with. In this paper, the authors defined the terms transparency and traceability as they are applicable to PAs of HLW disposal facilities and described basic attributes (e.g., completeness, clarity, and consistency) of transparent and traceable documents supporting a license application. Although the paper focused on the regulatory perspectives of transparency and traceability as applicable to HLW repositories, it also presented an overview of an approach that may be useful for developing a regulatory framework for any waste disposal facility.

S. Wyman of Whetstone Associates, Inc. presented a paper titled Performance Assessment of Class A Low Level Radioactive Waste Disposal Using The Discrete-Dispersed Source Method For Fate And Transport in Groundwater. The paper pertained to the disposal of LLW in a proposed new cell at the Envirocare of Utah disposal facility, which requires demonstration that ground water protection levels can be met for a period of 500 yr. To demonstrate compliance, the author evaluated leaching and transport of Class A radionuclides using the PATHRAE-RAD Performance Assessment Code for the Land Disposal of Radioactive Wastes. A method was developed to overcome the limitations of the closed form analytical solution used by PATHRAE, which is not capable of incorporating two dispersive components simultaneously. To overcome this limitation, the author simulated vertical dispersion by modeling non-dispersive vertical transport from a spatially diffused source. This new technique, referred to by the author as "discrete-dispersed source method," decomposed the results of the vertical dispersive solution into a number of starting concentrations and unsaturated zone lengths for the horizontal simulations. The results of numerous horizontal simulations were summed (using superposition) to determine the concentrations at the compliance point over time. This technique accounts for dispersion of radionuclides which potentially leach from the cell and migrate vertically to the water table and horizontally toward a compliance well. The PA included an evaluation of all Class A radionuclides and their potential impacts on groundwater. The critical factors for compliance include cell design (which affects infiltration through the cell after closure) and waste characteristics. Key components of the disposal cell design are slope length and angle, layer thickness, and hydraulic properties of cover materials. Significant waste characteristics include waste density, source concentration, half life, and sorption

coefficient (K_d) of each radionuclide. Sensitivity analyses were performed for these critical parameters. Using a combination of new and existing methods to assess the performance of the disposal cell, the author demonstrated compliance with ground water protection levels for 500 yr. Four of the 261 Class A radionuclides evaluated would be acceptable in limited concentrations, and the remaining radionuclides would be acceptable at the Class A limits or at the maximum theoretical concentration (specific activity). The author stated that the methods used to achieve these results can be applied to assess the performance of other disposal facilities.

M. Gallerand of ANDRA presented a paper titled Methodology of the Chemical Risk Assessment of Radioactive Waste Disposals and Application to the Metallic Lead Recorded in a Low-Level Waste Repository. ANDRA ensures that the impact of radiological species whose first hazard is a chemical hazard to human beings is included in safety assessments. The methodology adopted for toxicological risk assessment is based on the methodology developed for radiological risk. The chemical impact assessment requires defining and classifying toxic and non-toxic substances, determining the inventory of the toxic substances in the repository at the closure of operations, investigating the ways by which these substances are likely to be transferred through the different barriers of the repository and reach the outlets under various scenarios, quantifying the transfer into the food chain, and choosing criteria for use in the evaluation of the health effects for the exposed reference man. The result of the radionuclide transfer calculation is expressed as a dose to facilitate comparison with the legal criterion. Because chemical impact dose factors are not yet defined, the conversion of the ingested or inhaled quantity of a toxic element to a probability of effect has not been yet been done by ANDRA. Moreover, French and European regulations do not establish chemical criteria for nuclear plants for human health effects. Therefore, ANDRA has adopted indicators for ingestion and inhalation routes based on French drinking water regulations, Dutch soil regulations, and a defined tolerable weekly intake. To demonstrate application of the methodology, the author used the impact of lead in the environment of the Centre de l'Aube low level radioactive waste repository.

K. Chang et al. of Nuclear Environment Technology Institute, Korea Electric Power Corporation presented a paper titled Stochastic Continuum Analysis of Groundwater Flow Paths for Safety Assessment of a Radioactive Waste Disposal Facility. The authors developed a stochastic continuum modeling technique to simulate groundwater flow paths in fractured rocks. The model was formulated based on the discrete fracture network (DFN) model generated from field geometric and hydraulic data. The spatial distribution of permeability in the stochastic continuum model was defined by the probability distribution and variogram functions from permeabilities of the subdivided blocks of the DFN model. The consistency of travel time was found from numerical experiments using the stochastic continuum and DFN models. The authors found that the stochastic continuum model was an appropriate way to generate the probability distribution of groundwater velocity, which is required for the probabilistic safety assessment of a radioactive waste disposal facility in Korea.

L Prozorov of MosNPO, Russia, presented a paper titled Long Term Safety Assessment of "Radon" Type Facility. To provide a critical evaluation of the approaches and tools currently used in the long-term safety assessment of near-surface radioactive waste disposal facilities, toward the end of 1997 the IAEA launched the Coordinated Research Program on Improvement of Safety Assessment Methodologies for Near Surface Radioactive Waste Disposal Facilities (ISAM). The paper outlined an application of the ISAM methodology for safety assessment of Russian near-surface disposal facilities of low- and intermediate-level radioactive waste ("Radon" facilities). (Note: The facility type is known as "Radon," which should not be confused with radon gas.)

A. Sutherland of Portage Environmental, Inc. and others presented a paper titled Possible Impacts on DOE Order 435.1 Compliance for a LLW Facility Within a Larger CERCLA Site. The paper pertained to several DOE LLW disposal facilities that are surrounded by sites being remediated under the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA). To obtain a disposal authorization statement that is necessary for continued operation, active DOE LLW disposal facilities are required to have a reviewed and accepted PA and a composite analysis (CA). The CERCLA process is to reduce the uncertainty and conservatism in the selection of such things as (i) public receptor locations and exposure scenarios, (ii) level of emphasis and exposure conditions for the inadvertent intruder scenario, and (iii) type of waste disposal unit cover required. To demonstrate how the CERCLA process can impact the PA and CA analyses, the authors discussed the development of the PA and CA for the Interim Waste Management Facility (IWMF) and the Tumulus I and II facilities in Solid Waste Storage Area 6 (SWSA 6) of the DOE Oak Ridge Reservation. These facilities are above-ground, engineered units meant for long-term environmental isolation of LLW. The CERCLA assessment also addressed sources migrating from the adjacent, connected Bethel Valley watershed. The remedial action provisions and requirements developed for the CERCLA site were discussed relative to the PA and CA for the IWMF and Tumulus I and II under DOE Order 435.1. The authors concluded that land use planning under CERCLA provides a well defined public receptor location and exposure scenario, which at this site eliminates the consideration of the hypothetical public use of a groundwater well located just outside the 100 m buffer zone surrounding the facilities. This reduced potential doses by placing the receptor beyond 100 m from the source and by diluting any contaminants in surface water before they reached the receptor. The authors also concluded that integration of doses due to other (CERCLA) sources at the public receptor location will facilitate the CA analysis. Finally, they concluded that institutional controls that include perpetual maintenance and surveillance and periodic 5-year reviews of CERCLA actions where contaminants are not all removed will allow a less robust cover design for the IWMF, Tumulus I, and Tumulus II, since maintenance and surveillance activities will control site degradation by natural phenomena.

T. Sullivan of Brookhaven National Laboratory and others presented a paper titled Distributed Container Failure Models for the DUST-MS Computer Code. The authors described improvements to the code that allows simulation of distributed container failure rates. The model permits instant failure of all containers within a computational volume, uniform failure of containers over time, or a normal distribution of container failures. The model also permits a unique emplacement time for each modeled container and allows a fraction of the containers to fail at emplacement. The paper described model implementation, verification testing, and an example problem comparing releases from a waste form with a two-species decay chain as a function of failure distribution.

S. Kowall of INEEL presented a paper titled The DOE Vadose Zone Science and Technology Roadmap: A National Program to Address Characterization, Monitoring, and Simulation of Subsurface Contaminant Fate and Transport. The roadmap identifies research spanning the next 25 yr that is necessary to better predict the fate and transport of contaminants in the vadose zone. This will provide the basis for reducing scientific uncertainty in environmental remediation and, especially, vadose zone related long-term stewardship decisions across the DOE complex. Vadose zone issues are recognized as national problems affecting other federal agencies as well as state and municipal sites. The roadmap is intended to provide a common perspective on future science and technology needs in an effort to improve research and development investment decisions.

R. Halstead of the Agency for Nuclear Projects, State of Nevada and others presented a paper titled State of Nevada Studies of Potential Terrorism and Sabotage Against Spent Fuel Shipments. The State of Nevada

Agency for Nuclear Projects (NANP) recently sponsored two contractor studies of potential terrorism and sabotage against spent nuclear fuel shipments. In June, 1999 Nevada petitioned the NRC to amend its transportation safeguards regulations (10 CFR Part 73) and to reexamine the consequences of attacks on spent fuel shipping casks with a variety of weapons. NRC published the petition for rulemaking in September 1999 and accepted public comments through January 2000. NANP contractors are conducting additional studies of the radiological and economic consequences of successful acts of sabotage, terrorism, and other human-initiated events. These studies are part of the State's review of the DOE draft environmental impact statement for the proposed YM repository. The State is authorized to prepare an impact statement if the Secretary of Energy recommends the YM site for repository development.

IMPRESSIONS/CONCLUSIONS:

WM '01 addressed several topics of importance to CNWRA work with NRC. Insights from other federal agencies and from organizations conducting work at specific sites was valuable.

PROBLEMS ENCOUNTERED:

None.

PENDING ACTIONS:

None.

RECOMMENDATIONS:

CNWRA participation in this series of conferences should be continued.

S. Mohanty attended the Program Advisory Committee meeting on the final day of the conference to plan for the year 2002. He proposed a special session tentatively titled Regulatory Framework for the Proposed Repository at Yucca Mountain. Proposals have also been made to dedicate several sessions to topics related to YM. S. Mohanty emphasized the importance of maintaining a balance in the representation of agencies involved in the YM project at the conference.

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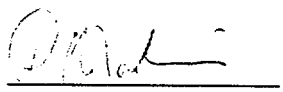

3/15/2001

P. Mackin
Assistant Director
Systems Engineering and Integration

Date