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POLICY ISSUE
(Information)

March 28, 1994

SECY-94-083

FOR: The Commissioners
FROM: James M. Taylor
Executive Director for Operations
SUBJECT: ANNUAL STATUS REPORT ON PROGRESS OF LOW-LEVEL RADIOACTIVE
WASTE PERFORMANCE ASSESSMENT DEVELOPMENT PROGRAM PLAN

PURPOSE:

To inform the Commission of staff's progress in carrying out the Low-Level Radioactive Waste Performance Assessment (LLWPA) Development Program Plan.

SUMMARY:

The Low-Level Radioactive Waste Performance Assessment Development Program Plan (SECY-92-060) was developed in response to a June 14, 1991, staff requirements memorandum (SRM). U.S. Nuclear Regulatory Commission staff has made significant progress over the past year in meeting the Phase I objectives of the plan. Staff has completed a draft "Branch Technical Position (BTP) on Performance Assessment for Low-Level Waste Disposal Facilities." This document has been distributed to all low-level waste (LLW) sited and host Agreement States, the Advisory Committee on Nuclear Waste (ACNW), the U.S. Department of Energy (DOE), the U.S. Environmental Protection Agency (EPA), and the United States Geological Survey (USGS) for review and comment. A staff briefing of ACNW is scheduled for March 1994 and there are plans to brief the Commission in April 1994. Staff has also constructed an integrated systems model of a hypothetical LLW disposal facility and has been carrying out an iterative series of analyses to test different modeling approaches,

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including uncertainty and sensitivity analyses. In addition, contractors have provided ancillary analyses on different system components to support staff modeling efforts. The staff has also gained PA experience through interactions with State efforts, other Federal agencies (e.g., DOE and the USGS), foreign countries (e.g., France, Spain, and Germany), and international organizations, such as the International Atomic Energy Agency (IAEA).

BACKGROUND:

This paper provides the Commission with an annual status report of progress in implementing SECY-92-060. This is the second annual report; the first was provided in SECY-93-060. The Plan, which was produced in response to a June 14, 1991, SRM, has two primary goals: (1) to enhance staff's capability to review, evaluate, and conduct a LLWPA; and (2) to develop regulatory guidance based, in part, upon staff and contractor LLWPA modeling work and lessons learned from the simulations.

The plan was divided into two phases. Phase I was focused on enhancing in-house capability and developing regulatory guidance for LLWPA based upon existing state-of-the-art technology. Phase II was originally intended to focus on: (1) maintaining and augmenting staff capability; (2) updating regulatory guidance; and (3) incorporating significant technological advances from research efforts into NRC's performance assessment (PA) capabilities. Staff was considering extending the test-case modeling to an arid site (in contrast to the humid site currently being evaluated under Phase I). Phase II, however, is being modified, by applying staff capability developed in Phase I, to conduct PA analyses for certain Site Decommissioning Management Plan (SDMP) sites, where appropriate data are available. Other objectives for Phase II would be maintained; however, implementation of these other activities would be delayed because of limited staff resources.

The LLWPA program plan is being carried out by the Performance Assessment Working Group (PAWG), which is composed of staff from both the Low-Level Waste Management Branch (LLWB), Office of Nuclear Material Safety and Safeguards (NMSS), and the Waste Management Branch (WMB), Office of Nuclear Regulatory Research (RES) (see Enclosure). As described in SECY-92-060 and SECY-93-060, PAWG members are involved in all aspects of LLWPA, including research, methods to enhance staff expertise, development of regulatory guidance, and coordination of PA activities with Federal, State, and international organizations.

DISCUSSION:

1. Implementing the Program Plan

1.1. Enhanced Staff Capability

The first program goal is to enhance staff's capability to review and evaluate a license applicant's LLWPA, including conducting confirmatory PA analyses, if necessary. The primary strategy for achieving this program goal has been to develop and to exercise a test-case PA of a hypothetical disposal system in a

humid environment, using actual site data and a staff-generated facility design and source term inventory. This has allowed staff to test the performance assessment methodology (PAM) and models and has increased staff experience, insight, and understanding in LLWPA. The test-case has also enabled staff to test different approaches to LLWPA developed for the BTP. The modeling effort also has benefited from experience in the high level waste (HLW) PA effort, particularly in the areas of uncertainty and sensitivity analysis.

The staff has completed development of a fully integrated systems code that links sub-models for infiltration, engineered barrier performance, source term, ground-water transport, surface-water transport, and dose. The structure of the integrated systems code allows sensitivity and uncertainty analyses to be conducted for the overall PA analysis. The code has been subjected to an evaluation program within PAWG, to document it, to verify that it is carrying out the intended calculations appropriately, and to identify and resolve bugs and internal inconsistencies. The model incorporates a one-dimensional (1-D) streamtube approach for radionuclide transport, with appropriate geometric considerations to address two- and three-dimensional (2-D, 3-D) features of the site hydrogeologic system. Staff has demonstrated, through analysis of an analytical solution to the problem, that a 1-D streamtube is appropriate for this case. The data input for this integrated model consists of a list of parameters, the expected range of each parameter value, and the expected distribution (e.g., normal or lognormal) of each parameter for the different sub-modeling areas. Several different conceptual models are being evaluated. The staff is currently conducting full sensitivity and uncertainty analyses, using the integrated LLWPA code, for a resident agriculture scenario at the simulated site boundary. The purpose of this work is to determine the sensitivity of the calculated dose to different parameters and also to provide the framework for assessing the appropriateness of potential regulatory positions. The fully integrated code is designed around the specific features of the hypothetical LLW disposal site and, therefore, is not intended to be a generic code to be applied to all LLW sites. Nevertheless, the approaches developed and lessons learned in exercising the test case have been very useful in developing the BTP.

The computer codes incorporated into the model (including newly developed codes) allow modeling of specific physical phenomena of concern (such as waste form leaching and transport of radionuclides) in the PA process. Many of the codes contain complex, iterative numerical procedures that require powerful computers to reach a solution in reasonable time. The ability of staff to use PA codes and to discern both the capabilities and limitations of different codes, is a fundamental part of enhancing staff's proficiency in reviewing and evaluating a license applicant's PA.

The enhanced computer hardware, acquired in fiscal year 1992 (FY92) (i.e., four IBM-compatible 486 machines for NMSS and one IBM compatible-486 machine for RES) along with associated software and support equipment has proved adequate for developing the test-case model. These fast, powerful personal computers (with considerable amounts of expanded/extended memory and large hard disk capacity) allow staff to load and manipulate a large variety of

computer codes. However, since each realization of the data set in the integrated LLWPA model requires 2 to 3 hours of 486 computer time, and staff is running hundreds of realizations to exercise the code, more complex analyses (e.g., 2-D or 3-D models) will require the use of a larger computer system, such as advanced 486 systems with fast processors or workstation systems. The proposed merger of LLW and HLW Divisions will make the HLW workstation system available for LLWPA. Staff will evaluate specific needs for additional units for LLWPA modeling activities. Recently RES has obtained two work station systems, which are dedicated for modeling. It is important to note that, because LLWPA analyses involve both simple and complex models and codes, the hardware requirements include a mix of 486 based computer systems, as well as more powerful systems.

The staff has also worked to achieve the goal of improved capability in LLWPA, through a number of other activities, including research activities described in SECY-92-060. To further enhance staff's capability to conduct and review LLWPAs, several workshops and meetings were conducted, in FY93, to enhance technology transfer to NRC staff from research and technical assistance contractors. In addition, in June 1993 NMSS/RES staff arranged a LLWPA meeting of NRC staff and several contractors to provide a technical review of the test-case modeling, including identifying potential problem areas (e.g., technical problems with data or inconsistencies in the models) and developing approaches for their resolution. This meeting also provided essential insights for developing the draft BTP.

NRC contractors have also been developing and evaluating codes suitable for PA modeling, and to supplement staff efforts, they are modeling specific parts of the test-case problem. These include: independent ancillary analyses of infiltration through a multi-layer cover; concrete degradation studies; source term modeling; geochemical modeling of radionuclide solubilities and sorption parameters; ground-water transport modeling in the saturated zone, and vapor-phase transport modeling in the unsaturated zone; surface water transport; air transport; and dose modeling. In addition, further development and improvement of the PAM and contractor input on LLWPA issues have been a significant help in developing the BTP. These projects are being documented and published as NUREG/CR documents, including: NUREG/CR-5927, Volume 1, which updates the PAM, August 1993; NUREG/CR-6070, which presents approaches on concrete barrier modeling in LLW disposal, November 1993; and the NUREG/CR-6114 series (Volume 1, published December 1993, which deals with applying the infiltration evaluation methodology; Volumes 2 and 3, which are in press, deal with vapor-phase transport analysis and ground-water flow and transport analysis, respectively).

1.2. Developing Regulatory Guidance

The second program goal is to develop regulatory guidance for LLWPA, in particular the BTP on LLWPA, and staff has also made significant progress in this area. Staff effort in developing the BTP on LLWPA is closely related to capability. The staff has completed a draft BTP for review by LLW sited and host Agreement States, ACNW, DOE, EPA, and USGS. The draft BTP has already been reviewed by NRC staff and by NRC contractors involved in LLWPA. The

principal guidance objective of the BTP is to provide license applicants and regulators with an acceptable methodology for performing technical analyses required in 10 CFR 61.13 to demonstrate compliance with the 10 CFR 61.41 performance objectives. This includes giving: (1) general guidance on an acceptable PA process that integrates site characterization and PA modeling; and (2) specific guidance on implementing NRC's PAM. The PAM was developed by NRC as one approach that may be followed in conducting a PA for a LLW disposal facility.

The revised schedule discussed in SECY-93-060 (the first annual status report) called for staff to prepare a draft BTP focusing on PA strategy and resolving policy issues by FY93. Subsequently, staff would incorporate revised sub-modeling area technical positions into the draft BTP in FY94. Staff, however, has completed both tasks, and the draft BTP sent out for review and comment is a complete document that incorporates five main sections. These sections of the BTP focus on the following objectives: (1) defining LLWPA in the context of the 10 CFR Part 61 regulatory requirements for LLW facility performance; (2) providing background information on LLW disposal, the NRC PAM and important issues in LLWPA; (3) describing an overall process for conducting PA modeling activities; (4) addressing important technical policy issues concerning interpretation and implementation of Part 61 technical requirements; and (5) providing guidance on acceptable modeling approaches for addressing technical issues about processes controlling LLW facility performance.

The goal of the review process is to receive comments from the sited and host Agreement States and appropriate Federal agencies, and to address these comments in revising the BTP. Staff will be briefing the ACNW on the BTP and test-case modeling in March 1994. A briefing of the Commission will follow in April. Subsequently staff will produce a revised draft BTP for publication in the Federal Register and public comment by all interested parties. Staff will also hold a public workshop on the BTP.

In addition, staff will continue to conduct the test-case modeling, including sensitivity and uncertainty analyses, using both staff resources and ongoing contractual technical assistance. This schedule will allow staff to address any outstanding technical issues. The staff will develop a NUREG on the test-case simulations to document the technical basis for the overall PA strategy and for specific sub-modeling area technical approaches. In addition contractor analyses of different sub-model areas of the test-case are being, and will continue to be, published as a series of NUREG/CR reports, which will provide further technical support for individual sub-modeling area technical positions. The Phase I test-case documentation is scheduled for completion in FY94. All of this work will be done within existing resource allocations. Because the BTP is an extensive and comprehensive guidance document, the need for developing a Regulatory Guide from the BTP will be reconsidered. Because of resource limitations, completing documentation of the test-case work may be extended into FY96, depending on the level of effort necessary for PA work on SDMP sites.

2. Interactions with Agreement States

During FY93, staff has had several interactions with Agreement States, where knowledge and experience gained from the LLWPA program have been directly applicable. For example, on June 4, 1993, NRC staff met with the State of North Carolina and provided an overview of the BTP development and test-case simulations. Staff also met with an individual from the State of Pennsylvania, to discuss LLWPA issues and approaches for modeling. In addition, on July 28, 1993, in Rockville, Maryland, staff (in conjunction with State Programs) participated in the LLW and Uranium Recovery Regulatory Workshop for Agreement States, which included a half-day session devoted to PA, including information on the PAM and strategies for modeling, the test-case simulations, and the development of the BTP. Staff also gave a presentation of this information at the LLW Host State Technical Coordinating Committee Meeting in Rockville, on August 24, 1993. The experience and knowledge gained from these LLWPA program activities permit direct feedback and input to staff's development of PA guidance. Staff has also worked to provide technology transfer to the Agreement States through various activities such as organizing workshops (discussed below) and distributing publications. Staff will continue these efforts in the future, as well as providing specific technical assistance when requested.

3. Interaction with National PA Activities

NRC staff has been active in national LLWPA activities, particularly in association with DOE. NRC staff is participating in the DOE PA Task Team (PATT) meetings, held approximately every four months. The purpose of PATT is to discuss and coordinate the LLW PA activities at DOE sites, identify and resolve technical issues, alert DOE headquarters to policy issues, and develop revised guidance for the disposal of DOE LLW. NRC staff also participates, as a non-voting member, in the DOE Peer Review Panel (PRP), which evaluates and determines the technical acceptability of LLWPAs for DOE sites and provides input to DOE HQ. Participation in both the PATT and PRP is beneficial to the NRC staff in developing regulatory guidance for commercial disposal facilities. Moreover, these activities provide an important means of coordinating NRC and DOE LLWPA endeavors.

Staff presented a day-long workshop on the LLWPA test-case modeling to the DOE/PATT in Gaithersburg, Maryland, on November 17, 1993. Because PATT members are practitioners of LLWPA and are directly involved in doing LLWPAs for DOE facilities, the workshop provided an excellent opportunity for technical discussion of issues in LLWPA and staff's test-case modeling efforts.

The staff has also continued interactions with the National LLW Management Program Office (NLLWMP), operated by EG&G at the Idaho National Engineering Laboratory (INEL) for DOE. This office provides technical assistance to the States under the 1985 Low-Level Radioactive Waste Policy Amendments Act. During FY93, the NRC staff had numerous technical interactions with the NLLWMP, involving activities such as joint planning of the annual DOE LLW Management Conference, to develop a comprehensive technical program on LLW PA;

and attendance by DOE LLW Program Office staff at selected NRC technical meetings. Staff is also discussing holding additional workshops on LLWPA through the NLLWMP.

Staff participated in a number of professional meetings, where topics pertaining to LLWPA were presented. Staff presented a number of papers on the development of LLWPA guidance and resolution of technical issues, and also participated in panel discussions on LLWPA at the DOE/LLW Management Conference in Phoenix, December 1 through 3, 1993, and the Waste Management '94 conference in Tucson, February 28 through March 3, 1994.

Staff helped organize and participate in a "Joint USGS-NRC Technical Workshop on Research Related to LLW Disposal," held at USGS headquarters in Reston, Virginia, from May 4 through 6, 1993. This workshop was the initial effort by NRC and USGS staffs conducted under the Memorandum of Understanding (MOU) between the two agencies. Over 60 participants from Agreement States, Federal agencies, DOE national laboratories, and private contractors meet to listen to ongoing USGS and NRC-funded research, and to discuss the technical issues involved. A USGS Water-Resources Investigations Report documenting the workshop proceedings is scheduled for publication in May 1994. Staffs from both the NRC and USGS are organizing the second joint project under the MOU, which is a special session on "Research Related to LLW Disposal," to be held at the American Geophysical Union (AGU) Meeting in Baltimore, May 23 through May 27, 1994.

Staff also organized a "Workshop on Performance and Modeling of Concrete as Engineered Barriers for LLW Disposal," in conjunction with staff at the National Institute of Standards and Technology, which was held in Gaithersburg, Maryland, from January 31 through February 2, 1994. There were more than 80 participants representing States, national laboratories, universities, consulting organizations, and representatives of five foreign countries (France, Spain, Switzerland, Great Britain, and Canada).

4. Interaction with International PA Efforts

As described in SECY-92-060, staff has continued cooperation in international efforts concerning LLW disposal. The staff has participated, as a consultant to the IAEA, in the Coordinated Research Program (CRP) on the Safety Assessment of Near-Surface Radioactive Waste Disposal Facilities. The CRP is conducting test-case programs similar to NRC's. The staff and a contractor, Sandia National Laboratory, are participating in these PA modeling exercises. A consultant meeting was held from May 9 through 14, 1993, in Vienna, Austria. The meeting focused on finalizing the first test-case problem write-up and further development of the second test-case problem on LLW safety assessment for the CRP. In addition, plans were developed for a three week course for international participants in LLW PA modeling that was held at Argonne National Laboratory, February 14 through March 4, 1994. Two staff members gave one-day lectures at this training course. Several Agreement State representatives also attended this course under NRC's Agreement State training program.

As part of NRC's research information exchange activities with the French Commission de l'Energie Atomique (CEA) and the Swiss National Cooperative for the Disposal of Radioactive Waste (NAGRA), staff gave overviews of the PA program in Paris, France and Wettingen, Switzerland on October 14 and 15, 1993, respectively. At that time invitations were extended to CEA and NAGRA representatives to attend the concrete workshop discussed above.

In addition, staff members were able to visit disposal sites in Spain, France, and Germany, in FY93. Staff also provided a half-day briefing on LLWPA in a meeting with representatives from France on LLW disposal, held in Rockville, on March 31, 1993. February 14 through 18, 1994, staff discussed LLW disposal issues with representatives from the Czech and Slovak Republics and the Ukraine. The interaction during these visits, and the information on different approaches to LLW disposal and LLWPA in other countries, have proven to be very useful in evaluating domestic issues and approaches.

5. Resource Impacts

In SECY-93-060, staff provided a revised budget estimate of direct resources necessary to support Performance Assessment activities in FY93. The following data compare the budget estimate with actual staff time expended and contractor support obligations.

	FY93 Budget Estimate	FY93 <u>Actual</u>
NMSS/LLWB		
FTE	4	4.3
Contractors	\$500K	\$678K
RES/WMB		
FTE	2.8	2.8
Contractors	\$1.025M	\$1.025M

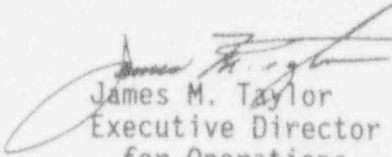
Additional resources of 0.3 FTE and \$178K were obtained from staff overtime expended and the reprogramming of FY93 funds.

In FY94, staff has budgeted resources of 3.7 FTE and \$337K for NMSS and 2.0 FTE and \$850K for RES to: (1) publish the BTP for public comment and hold a public meeting; (2) publish documentation of the test-case and ancillary analyses; (3) provide technical assistance on LLWPA to host Agreement States as requested. In addition, staff will commence some work on specific SDMP sites, to determine the applicability of the LLWPA methodology to site remediation efforts.

The Commissioners

- 9 -

COORDINATION: The Office of the General Counsel (OGC) has reviewed this paper and has no legal objection.


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Executive Director
for Operations

Enclosure: PAWG member list

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NOTE: Hydrology includes: Infiltration, Ground Water, Surface Water Sub-Modeling Groups

Enclosure