POLICY ISSUE
(Information)

July 18, 1994 SECY-94-187

FOR: The Commissioners

FROM: James M. Taylor, Executive Director for Operations

SUBJECT: STAFF REQUIREMENTS MEMORANDUM, "BRIEFING ON NRC HIGH-LEVEL WASTE RESEARCH PROGRAM," NOVEMBER 3, 1993

PURPOSE:

Respond to Commission questions arising from the October 27, 1993, staff briefing on NRC's High-Level Waste (HLW) research program.

BACKGROUND:

On October 27, 1993, the staff briefed the Commission on the NRC's HLW research program. Subsequent to that meeting, the Commission requested additional information conveyed by a Staff Requirements Memorandum, dated November 3, 1993 (Enclosure 1). Specifically, the Commission requested the following information.

The Commission requested further information on the process used to make decisions on the use of resources (including allocation of FTE's) for research, how research priorities are set, and the point where a specific research task can be considered complete. The staff response to this request is contained in Enclosure 2.

The Commission requested further information on the results which have come from research related to the high level-waste issue. A list of products from the HLW research program is provided as Enclosure 3.

NOTE: TO BE MADE PUBLICLY AVAILABLE IN 10 WORKING DAYS FROM THE DATE OF THIS PAPER

CONTACT:
Frank A. Costanzi, RES
(301) 415-6250

The Commission also requested information on potential impacts on conduct and schedule of research tasks based upon current and planned level of resources (FY 94-96). I have recently completed an overall review of the agency's research programs, including HLW and LLW research. This review has provided the basis for the current and planned resources in HLW research for FY 94-96. This information is provided as Enclosure 4. However, the Commission should note that on February 3, 1994, Mel Silberberg, retiring chief of the Waste Management Branch, RES, wrote a memorandum to Bill Morris, the Director of the Division of Regulatory Applications, expressing his views that the HLW research program (and LLW as well) was seriously understaffed. RES management has considered this view, and while acknowledging the hard work and dedication of the Waste Management Branch staff, cannot agree with the conclusion of Mr. Silberberg's analysis. On the average, each project manager in the Waste Management Branch manages about $1M of research. This figure is about average for project management research throughout the Office of Research. Moreover, the fact that nearly all HLW research is conducted at the NRC's Center for Nuclear Waste Regulatory Analysis provides an assist to management of the HLW research program generally not available to other research programs where no integrating organization is available to assist the staff in assuring coherency of the research. Finally, recent changes in the agency's LLW program have been reflected in a reduction in the funding of LLW research, which in turn will lessen the overall demands on the members of the Waste Management Branch, since most manage both HLW and LLW research. For these reasons, I agree with RES management that the resources allotted to the HLW research program, while tight, are adequate. Mr. Silberberg's memorandum is provided as Enclosure 5.

James M. Taylor
Executive Director
for Operations

Enclosures:
1. SRM dated November 3, 1993
2. Resource Allocation Process
3. List of HLW research products
4. Allocation of Resources
5. Memorandum dated February 3, 1994

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ENCLOSURE 1

SRM-930441

ACTION - Beckjord, RES

Cys: Taylor
Sniezek
Thompson
Blaha
Knubel
Scroggin

UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D.C. 20555

OFFICE OF THE SECRETARY

November 3, 1993

IN RESPONSE, PLEASE REFER TO: M931027

MEMORANDUM TO: James M. Taylor
Executive Director for Operations

FROM: Samuel J. Chilk, Secretary

SUBJECT: STAFF REQUIREMENTS - BRIEFING ON NRC RESEARCH PROGRAM ON HIGH LEVEL WASTE, 10:00 A.M., WEDNESDAY, OCTOBER 27, 1993, COMMISSIONERS' CONFERENCE ROOM, ONE WHITE FLINT NORTH, ROCKVILLE, MARYLAND (OPEN TO PUBLIC ATTENDANCE)

The Commission was briefed by the NRC staff on the research program on high level waste.

The Commission requested further information on the process used to make decisions on the use of resources (including allocation of FTE's) for research, how research priorities are set, and the point where a specific research task can be considered complete.
(~~EDO~~) RES (SECY Suspense: 12/17/93) 9300184

While the briefing focused on the ongoing research program, the Commission requested further information on the results which have come from research related to the high level waste issue.
(~~EDO~~) RES (SECY Suspense: 12/17/93) 9300184

The Commission also requested information on potential impacts on conduct and schedule of research tasks based upon current and planned level of resources (FY 94-96).
(~~EDO~~) RES (SECY Suspense: 12/17/93) 9300184

cc: The Chairman
Commissioner Rogers
Commissioner Remick
Commissioner de Planque
OGC
OCA
OIG
Office Directors, Regions, ACRS, ACNW, ASLBP (via E-Mail)
PDR - Advance
DCS - P1-24

ENCLOSURE 2

PROCESS FOR ALLOCATING RESOURCES

FOR

HIGH-LEVEL RADIOACTIVE WASTE RESEARCH

The Commission requested further information as to the process by which decisions are made on the use of resources for HLW research, how priorities are set, and the point where a specific research task can be considered complete.

The determination as to the allocation of resources for HLW research, both program support funds and FTEs, is the result of an iterative process performed at all levels of management of the Agency, including the Commission. This determination is accomplished through the annual updating of program plans and assumptions, in consideration of the agency's overall mission in general, and the role of the agency's several programs, including the HLW program, within that mission. Once identified, the number, scope, and complexity of research projects within each technical program area needed to support the agency's mission, and the number of staff needed to effectively manage those projects, become the major factors in allocating both FTE and program support funding. The resource commitment to achieving the agency's HLW regulatory goals and objectives is defined through the budget process, and is reflected in the Agency's Five-Year Plan.

The determination of what research areas to pursue and their relative priorities within the HLW research program is driven primarily by the Agency's policy of ongoing review of DOE's activities and schedules for the characterization of the Yucca Mountain site--DOE's primary repository development activity at present--including surface testing, and the development of and in-situ testing at DOE's Yucca Mountain Exploratory Studies Facility [ESF]. Accordingly, the majority of resources allocated to HLW research at this time, are being expended in site-related disciplines--geology, hydrology, and geochemistry--as can be seen in Figure 1.

The question of which particular research topics to pursue within any given discipline and what portion of the HLW research budget to allocate to each is answered by reflecting upon what data, analytical tools and expertise are needed by the NRC staff to maintain the ongoing review of DOE activities, and ultimately review DOE's license application. Staff identification of where lie the most significant uncertainties or unknowns with respect to the reviews it must carry out has been articulated in user need memoranda from NMSS, and provides the basis for the HLW research program.

Within the last year, a process that begins with a systems engineering approach called Systematic Regulatory Analysis (SRA) has been used by the NRC staff to prepare the strategies, procedures, and acceptance criteria for both the licensing review of the Yucca Mountain repository--the License Application Review Plan (LARP)--and the ongoing review of DOE site characterization activities. The relation of the HLW research program to the elements of the LARP and other components of the Agency's HLW licensing program is illustrated in Figure 2.

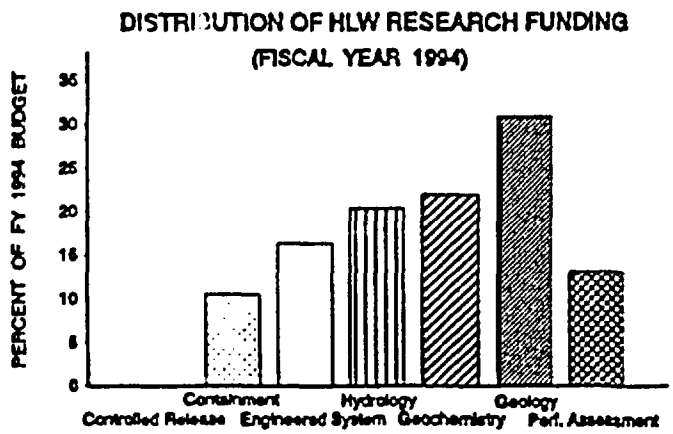
DISTRIBUTION OF HLW RESEARCH FUNDING
(FISCAL YEAR 1994)
PERCENT OF FY 1994 BUDGET
35
30
25
20
15
10
5
0
Containment
Controlled Release
Engineered System
Hydrology
Geochemistry
Geology
Perf. Assessment

Figure 1

RELATIONSHIP OF NRC HLW RESEARCH
TO LICENSING PROGRAM

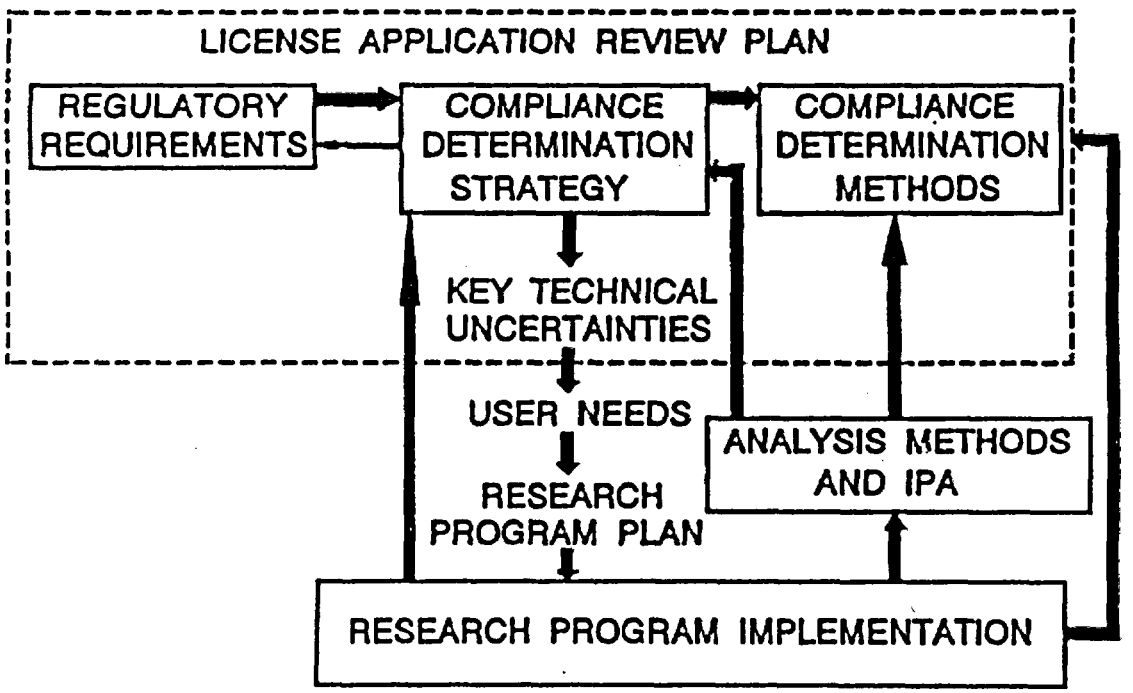

Figure 2

Of particular relevance to the NRC research program is the development of individual review strategies which define the types of review for the various review topics. In the development of the review strategies, uncertainties determined to be particularly important to demonstrating repository performance are identified as Key Technical Uncertainties (KTU). KTUs are identified as potential subjects for NRC research if they are considered to be most difficult to resolve, and relying on DOE studies alone will not permit an independent review of DOE's resolution of the KTU. For example, particular KTUs for which the tools that the NRC staff needs to perform its licensing review do not exist, or areas for which there is a lack of fundamental technical or scientific knowledge that the staff can access to support its review of DOE's work addressing a KTU, are identified as areas where NRC research is needed. These "research" KTUs will be prioritized by NMSS within the overall considerations of DOE activities noted above, factoring in other concerns such as availability of funding, program stability for integrated efforts such as performance assessment, and long term continuity of critical programs such as field experiments. They ultimately become the basis for revised user needs from NMSS, to be used by RES staff to develop detailed statements of work (SOW).

It should be emphasized that this newly begun process is a joint effort among the staffs of NMSS, RES, and the Center for Nuclear Waste Regulatory Analyses, and will render a more systematic and traceable method of determining the content of the Agency's HLW research program. It will provide a confidence in both the completeness and appropriateness of the research program that heretofore has been difficult to demonstrate. However, based on the staff's initial identification of KTUs in carrying out the SRA process, there is no indication that any major uncertainty has gone undetected or that ongoing or completed research should not have been initiated. This has added confidence that the high degree of interoffice coordination instituted at the management and staff level in the waste management program is providing a well-focused, efficient, and productive research program.

The point at which research on a specific topic should end is reached when a basic question raised in developing a review strategy has been answered in a sufficiently complete manner that a licensing decision can be made, or a question can be put properly to DOE so that it can provide the basis for a licensing decision. The appropriate end point for a research project is defined in the SOW for that project by the description of the product of the research--a data base, a model, an answer to a specific technical question. A combination of annual review of KTUs, appropriate peer review of research progress and results, and staff judgement, considering the totality of information available, including the results from Iterative Performance Assessment (IPA) activities, enables the staff to review ongoing projects against the questions raised in developing the review strategy, and modify projects so that research is neither conducted beyond regulatory need nor stopped short of providing the staff of needed tools, data, or expertise.

It should be emphasized that the NRC research program is not attempting to perform any research or other investigation that DOE ought to be undertaking. Rather, HLW research seeks to provide the knowledge and/or tools not already in its possession, that the NRC staff needs for its independent judgement that

the investigative, design, and analytical work performed by DOE is proper, credible, and sufficient (complete in both scope and depth) to support the license application. The burden is on DOE to provide both the data and analyses to support its demonstrations of compliance. The NRC HLW research program will not collect data to characterize the Yucca Mountain site. The HLW research program may collect some confirmatory data of the same nature as data that DOE also must collect, such as thermochemical and corrosion data, or data on hydrologic properties of unsaturated fractured tuff, to review DOE methods of experiment, testing, measurement, or analysis. However, DOE still has the burden of collecting all the data, performing all the analyses, and addressing all the uncertainties needed to support its license application.

ENCLOSURE 3

HIGH LEVEL RADIOACTIVE WASTE RESEARCH

LIST OF PRODUCTS

PERFORMANCE ASSESSMENT ISSUE: WHAT PERFORMANCE ASSESSMENT METHODS ARE SUITABLE FOR USE BY DOE FOR DEMONSTRATING ACCEPTABLE REPOSITORY PERFORMANCE?

Question: What techniques will support NRC pre-licensing interactions with DOE and contribute to a basis for review of DOE's performance assessment contained in its license application?

Product: An initial approach for performance assessment of a high-level radioactive waste disposal facility in unsaturated, fractured tuff that includes screening methods for identifying the more important processes and events, simulation models, statistical techniques for addressing sensitivity and uncertainty, methods for treating event probabilities, and implementation guidance. (NUREG/CR 5701 (July, 1991))

Use: Provided a basis for the NRC iterative performance assessment activity. This activity will assist the NRC staff to focus comments concerning DOE site characterization activities on those issues most important to repository performance, and ultimately will evolve into a method to review DOE's performance assessment.

SITE ISSUE: WHAT MEASUREMENT TECHNIQUES ARE APPROPRIATE FOR DETERMINING HYDROLOGIC PROPERTIES AND PARAMETER VALUES?

Question: What is the basis for NRC's review of DOE's program for characterization of the hydrology of Yucca Mountain?

Product: Field and laboratory evaluation of hydrologic measurement techniques, and generation of data sets from field measurements of ground-water flow and transport through unsaturated fractured tuff similar to Yucca Mountain. (NUREG/CR-4655 (May 1987), NUREG/CR-4654 (July 1987), NUREG/CR-5239, (January 1989), NUREG/CR-5596 (August 1990), NUREG/CR-5482 (February 1990), NUREG/CR-5581 (January 1991)).

Use: Technical basis and associated data for evaluating DOE's program of hydrologic measurement at Yucca Mountain.

SITE ISSUE: WHAT IS THE NATURE OF TECTONIC PROCESSES OPERATING IN THE CENTRAL BASIN AND RANGE?

Question: Can natural analogues be used to gain insights as to the tectonic processes that may affect the Yucca Mountain repository?

Product: Workshop to assess the role of natural and archeological analog studies in the context of the US HLW disposal program. Explored the full range of processes which may be better understood by studying analogous systems or sites. (Proceedings on The Role of Natural Analogues in Geologic Disposal of High-Level Nuclear Waste (CNWRA 93-020))

Use: Confirmed the utility (with limitations) of natural analogue studies, to both DOE and NRC programs. Several sites/systems discussed at this meeting are now the focus of NRC or DOE investigations (e.g. New Zealand hydrothermal fields (DOE), Santorini (NRC), Black Mountains (NRC)).

Question: At what locations should NRC pursue natural analogue studies?

Product: A comprehensive literature review of national and international natural analog studies conducted over the last ten years to identify potential sites for research to extend the range of data for validation of performance assessment models. (CNWRA 90-008)

Use: Basis for the initial decision to investigate the Peña Blanca and Santorini sites.

SITE ISSUE: WHAT ARE THE CHARACTERISTICS AFFECTING GROUND-WATER FLOW AT YUCCA MOUNTAIN?

Question: What are the relative contributions to ground-water flow of the rock matrix and fractures within the rock in the unsaturated fractured tuff of Yucca Mountain?

Product: DCM3D - Computer program modeling unsaturated fractured rock. The rock matrix and fractures are treated as two separate but interacting continua. (NUREG/CR 5536 (Feb., 1991))

Use: The role of fractures in evaluation of flow and transport at Yucca Mountain is a critical uncertainty in assessing the migration of radionuclides from the disposal facility. The DCM3D computer program is being used to test assumptions about the relative contributions of fracture and matrix flow to the movement of water through the repository.

Question: What is the basis for NRC's review of DOE's characterization of the hydrology of Yucca Mountain?

Product: Evaluation of current ground-water flow and transport theory, data analyses strategies and methods, and modeling techniques of the hydrologic properties unsaturated, fractured rock. (American Geophysical Union Monograph 42, and NUREG/CR-0040 (June 1993))

Use: Basis for review of DOE's quantitative description of ground-water flow and transport at Yucca Mountain.

Product: BIGFLOW - A three-dimensional code simulating ground-water flow in variably saturated, heterogeneous, fractured geologic media. (NUREG/CR-6028 (June 1993))

Use: Review of DOE's quantitative description of ground-water flow and transport at Yucca Mountain.

Product: An approach for analyzing and evaluating large-scale unsaturated flow in heterogeneous, stratified, and fractured geologic media related to HLW sites. (Neuman, S.P., "Stochastic Continuum Representation of Fractured Rock Permeability as an Alternative to the REV and Fracture Network Concepts," in the Proceedings of the 28th US Symposium of Rock Mechanics, Tucson, Arizona, June 29-July 1, 1987, pp. 533-561.), Neuman, S.P., "Universal Scaling of Hydraulic Conductivities and Dispersivities in Geologic Media," Water Resources Research, American Geophysical Union, Vol. 26, No. 8, pp. 1749-1758, August 1990, and NUREG/CR-5743 (August 1991)).

Use: Technical strategies for examining assumptions, uncertainties, and data analyses techniques involved in calculating flow through fractured, unsaturated geologic media on the scale relevant to the Yucca Mountain site.

SITE ISSUE: WHAT ARE THE CHARACTERISTICS AFFECTING RADIONUCLIDE TRANSPORT AT YUCCA MOUNTAIN?

Question: What will be the post-emplacement geochemical environment at Yucca Mountain?

Product: Model simulations of expected rock/water/gas chemistry at Yucca Mountain and at elevated post-emplacement temperatures. (Murphy, W.M. (1993) Geochemical models for gas-water-rock interactions in a proposed nuclear waste repository at Yucca Mountain, Nevada. Focus '93, Site Characterization and Model Validation, American Nuclear Society, La Grange Park, IL, (in press))

Use: Simulated environmental conditions for modeling and experimental studies of waste package stability, source term, and radionuclide transport.

Product: Thermodynamic data and associated models of Yucca Mountain zeolite minerals. (Pabalan, R.T. (1991) Nonideality effects on the ion exchange behavior of the zeolite mineral clinoptilolite. (Mat. Res. Soc. Symp. Proc., v. 212, p. 559-567), Murphy, W.M, R.T. Pabalan, J.D. Prikryl, and C.J. Goulet (1992) Dissolution rate and solubility of analcime at 25°C. (In Kharaka, Y.K., and A.S. Maest (eds.) Proc. 7th Internat. Symp. Water-Rock Interaction, Balkema, Rotterdam, p. 107-110.), Pabalan, R.T. and Bertetti, F.P. (1994) Thermodynamics of ion-exchange between Na^{+}/Sr^{2+} solutions and the zeolite mineral clinoptilolite. (Mat. Res. Soc. Symp. Proc., v. 333 (submitted)), and Pabalan, R.T. (1994) Thermodynamics of ion-exchange between clinoptilolite and aqueous solutions of Na^{+}/K^{+} and Na^{+}/Ca^{2+}. (Geochim. Cosmochim. Acta (submitted))).

Use: Assess the response of sorptive minerals at Yucca Mountain (stability and hydrogeochemistry) to the heat from emplaced waste (significant to waste package and waste form alteration and radionuclide transport). Incorporation of the behavior of zeolytes in performance assessments.

Question: To what extent will the radionuclides in the HLW be retarded by their interaction with the tuff of Yucca Mountain?

Product: Database for the MINTEQA2 Sorption/Speciation code was expanded to include thermodynamic data for important radionuclides. Actinide sorption on simple hydroxide minerals and more complex rock-forming minerals such as clays, micas, and zeolites was assessed. Strengths and weaknesses of mechanistic models (based on surface complexation theory) were identified and recommendations were made for streamlining modeling approaches. (Turner, D.R. (1993) Mechanistic approaches to radionuclide sorption modeling. CNWRA 93-019, Center for Nuclear Waste Regulatory Analyses, San Antonio, TX. Turner, D.R., Griffin, T., and Dietrich, T.B. (1993) Radionuclide sorption modeling using the MINTEQA2 speciation code. Mat. Res. Soc. Symp. Proc., v. 294, 783-789.)

Use: Treatment of retardation processes in performance assessment transport calculations.

Product: Measurements of the sorption of actinides, particularly uranium, on geologic media identified key parameters that are likely to control the sorption and retardation of actinides at the Yucca Mountain. (Pabalan, R.T., Prikryl, J.D., Muller, P.M., and Dietrich, T.B. (1993) Experimental study of uranium(6+) sorption on the zeolite mineral clinoptilolite. Mat. Res. Soc. Symp. Proc., v. 294, 777-782.)

Use: Experimental data which can be used to evaluate DOE treatment of actinide sorption.

Product: Coupled hydrogeochemical transport code that simulates the formation of uranium ore bodies. Includes geochemical and thermodynamic data specifically for uranium minerals, in a coupled transport - chemistry code(Raffensperger, J., 1993, Ph.D. Dissertation, Johns Hopkins University).

Use: Check simplified transport models used in performance assessment calculations.

Product: NEFTRAN II - A computationally efficient computer program modeling radionuclide transport, employing a set of one dimensional flow paths to approximate a detailed 3D treatment of fracture and matrix inhomogeneities and interactions. It includes matrix

diffusion for addressing the interaction between fracture and matrix concentrations, treats decay chains, and keeps track of daughter concentrations. (NUREG/CR 5618 (Feb., 1991))

Use: Used in support of the IPA effort. Specifically, NEFTRAN II is used to test modeling assumptions about the geochemistry of an HLW repository. It will be used in reviewing DOE's performance assessment calculations.

ENGINEERING ISSUE: WILL THE WASTE EMPLACEMENT DRIFTS AND BOREHOLES AT YUCCA MOUNTAIN REMAIN OPEN DURING THE RETRIEVAL PERIOD, AND WILL THEY BE STABLE DURING THE POST RETRIEVAL PERIOD?

Question: How will the excavated shafts and tunnels respond to stresses and forces in the host rock of Yucca Mountain?

Product: An empirical model of rock joint response to pseudostatic and dynamic loading. (CNWRA 93-013)

Use: Will be used to assess DOE data and models of response of excavated areas to static and dynamic loading.

Product: Development of a rock joint dynamic shear test apparatus. (CNWRA 90-005)

Use: Generate data to test rock joint models that in turn will be used to evaluate the stability of underground openings in the repository.

Product: Comparison of various rock mechanics codes against benchmark analytical problems. (CNWRA 90-006, CNWRA 90-004, CNWRA 91-020, CNWRA 92-015)

Use: Identified two codes, UDEC and 3DEC, that appear to be appropriate simulators of jointed rock behavior. These will be used in review of DOE repository design.

Question: What are the likely effects of seismic events in the Yucca Mountain area on the repository openings?

Product: A critical assessment of the literature addressing seismic effects on rock mass and ground-water proximate to underground excavations. (NUREG/CR 5440 (June, 1991), and CNWRA/89-001)

Use: Review of DOE's design of waste emplacement areas.

Product: Field measurements on the effect of mine seismicity on a jointed rock mass. Demonstrated that cumulative deformation needs to be considered in repository design. (CNWRA 92-012)

Use: Review of DOE's design of waste emplacement areas

Question: What are the likely effects of the heat from the emplaced wastes on repository performance?

Product: Evaluation of existing codes modeling coupled thermal-hydrologic-mechanical effects in the region proximate to the waste emplacement area. (CNWRA 91-005, 93-002)

Use: Review of DOE's assessment of the thermal effects of the emplaced wastes upon the repository performance.

ENGINEERING ISSUE: HOW LONG WILL SHAFTS AND BOREHOLES REMAIN SEALED?

Question: What are the materials and design parameters of effective seals in fractured tuff?

Product: Experimental assessment of the permeability and bond strength of cement/bentonite (NUREG/CR 4295 (February, 1991), NUREG/CR 4541 (March, 1987), NUREG/CR 5683 (March 1991), NUREG/CR 5684 (April, 1991), and NUREG/CR 5686 (June, 1991)), bentonite, and bentonite/crushed rock (NUREG/CR 5685 (July, 1992)) grouts for sealing rock fractures. This work established relationships between seal permeability and seal composition and design parameters, such as normal stress, minimum length to diameter ratios, and minimum bentonite to cement ratios, characteristic of low permeability seals in fractured tuff.

Use: Review of DOE plug and seal design and practice.

ENGINEERING ISSUE: HOW LONG WILL THE WASTE PACKAGE CONTAIN THE HLW?

Question: What form of corrosion of waste packages can be expected at the Yucca Mountain repository?

Product: Model for assessing the rate of carbon steel container degradation by pitting and crevice corrosion. (NUREG/CR 5709 (1992))

Use: Data and model calculations used to assess DOE preliminary design information and assertions in study plans that uniform corrosion would be the dominant failure mechanism for waste containers. Largely due to this work, pitting and crevice corrosion are now considered potential failure mechanisms and are being addressed by DOE.

Product: Thermodynamic model of pitting corrosion in copper. (Journal of Nuclear Materials, vol. 190, pp. 329-342; Materials Problems in Art and Archeology (MRS proceedings) pp. 1047-1053 and 1055-1063)

Use: Assessment of pitting corrosion of copper alloy container material (one of DOE's candidate materials).

ENGINEERING ISSUE: HOW CONFIDENTLY CAN SHORT TERM LABORATORY TESTS BE USED TO PREDICT LONG TERM PERFORMANCE?

Question: Do corrosion pits and crevices grow at a constant rate over long times?

Product: Method for determining whether corrosion (pitting or crevice), once initiated, will be self limiting. (NUREG-CR 5817 (1993) and CNWRA 93-015 (1993))

Use: Relate local geochemistry and pit geometry to the local electrochemistry within the pit or crevice, to assess the long term performance of waste package materials.

Question: How corrosion resistant are waste package materials currently under consideration by DOE?

Product: Factorial experiments conducted to generate a data base describing the susceptibility of iron, nickel, and copper alloys to potential degradation mechanisms over a range of repository environments. (CNWRA annual and semi-annual reports (1989-1993))

Use: Review of DOE waste package design.

Product:	Electro-chemical computer models of corrosion processes. (CNWRA 93-021)
Use:	Incorporation of corrosion processes in performance assessment models to evaluate DOE compliance with substantially complete containment requirement.

SOURCE TERM ISSUE: AT WHAT RATE WILL RADIONUCLIDES ENTER THE Ground-water SYSTEM?

Question: How will the elevated temperatures from the emplaced wastes affect the hydrologic properties of the site near the waste emplacement area?

Product: PORFLOW - Computer program modeling two-phase flow and transport of heat and mass proximate to the emplaced wastes. (NUREG/CR 5991 (Feb., 1993))

Use: Calculations of radionuclide release rates from the engineered barrier system.

Product: Review of analytical techniques and experimental investigations for assessing hydrothermal flow in partially saturated geologic media. (NUREG/CR-6026 (July, 1993))

Use: Will establish the extent to which hydrothermal laboratory tests can be used to represent heat and mass flow in repository size systems.

ENCLOSURE 4

ALLOCATION OF RESOURCES

TO

THE HLW RESEARCH PROGRAM:

Resource levels, both dollars and FTEs, are assigned to the HLW research program in the course of the preparations for the agency's budget submittal. Targets are generally specified by the EDO and submittals are required to be written to the assigned budget level. Impact assessments are submitted for any change in budget level and are reviewed by all levels of management. In recent years there has been a gradual reduction in the number of FTEs allocated to the HLW research program from 9 in FY 90 to 6.3 in FY 94, while the funding allocation has increased from $4.2M in FY 90 to $6.4M in FY 94. The FTE decrease reflects 1) the elimination of two positions that were dedicated to rulemaking because delays in projected regulation development reduced the need, and 2) elimination of a performance assessment specialist position which was no longer needed with the successful transfer of the performance assessment methodology developed for NRC by Sandia to the CNWRA. Current planning calls for the FY 94 levels to persist through FY 96. At these FTE and program funding levels, all necessary NRC HLW research is being accomplished.

Table 1 lists the currently staffed positions in the Waste Management Branch in the Office of Research, the expertise of the incumbent staff member, their principal assignments and the split of their time between high-level waste and low-level waste activities. Experience is not shown directly but all staff have been with the Commission, DOE, or State government working in earth science or waste programs for at least nine years.

Table 2 groups the above positions by expertise. At present, the mix of technical expertise is well matched to carrying out a research program focused primarily on site characterization questions. As the DOE program proceeds, and the focus shifts away from site questions to more materials and wasteform related issues towards the end of the decade, a different mix of technical specialties is likely to be needed.

WASTE MANAGEMENT BRANCH STAFF RESOURCES			
Staff Position	Expertise	HLW Projects Managed	% HLW
Modelling Analyst	Simulation modelling of waste disposal systems. (MS in Physics)	Performance assessment methodology projects; member of HLW IPA program.	85
Hydrogeologist	Evaluation of hydrogeologic systems. (MS in Hydrogeology, certified professional hydrogeologist (AIH))	Projects on stochastic methods and regional hydrology at CNWRA and Apache Leap field program and theoretical support project at U of AZ; Vice Chairman of INTRAVAL; representative to Federal Water Resources Research Committee.	60
Senior Program Manager	Fluid dynamics. (PhD in Mechanical Engineering)	Program Element Manager for all CNWRA research projects and manager of thermohydrologics project.	100
Geotechnical Engineer	Geotechnical engineering, performance evaluation of engineered systems. (MS in Geotechnical Engineering, licensed professional engineer)	Projects on sealing and seismic response of underground openings; grant with NAS geotechnical board; representative to international DECOVALEX project.	70
Geochemist/Volcanologist	Geochemistry, volcanology, assessment of hydrothermal/geothermal systems. (PhD in Geophysics and Igneous Petrology)	Projects on volcanism in the Basin and Range, Field Volcanism, and Geochemical Analogues; representative to NAWG Core Group and Oklo Steering Group; modelling of hydrothermal effects of dike intrusions.	90

WASTE MANAGEMENT BRANCH STAFF RESOURCES			
Staff Position	Expertise	HLW Projects Managed	% HLW
Geochemist	Geochemistry, geology. (PhD in Geochemistry)	Projects on unsaturated mass transport, sorption mechanisms for modelling, contemporaneous deformation in the Death Valley Region, and tectonics of the basin and range.	90
Metallurgist	Chemical metallurgy, modelling of corrosion processes, microbiological corrosion. (PhD in Metallurgical Engineering)	Project on integrated waste package experiments, work on modelling of corrosion processes.	30
Radiochemist	Radiochemistry, radioactive waste forms, waste streams, water chemistry. (PhD in Chemistry and Nuclear Chemistry)	Supports HLW performance assessment activities.	10
Hydrogeologist	Hydrogeology, simulation modelling of hydrogeologic systems. (PhD in Hydrogeology)	Supports HLW performance assessment activities.	10
Acting Section Leader (Senior Geologist)	Geology, seismology. (PhD in Geology)	Supports HLW performance assessment activities; representative to Yucca Mountain team meeting.	25
Section Leader (Environmental Analyst / Physical Scientist)	Physics, environmental engineering. (PhD in Nuclear Physics)	HLW project on overall research.	60

RES HLW TECHNICAL STAFF EXPERTISE
Hydrogeology
Geochemistry
Geology (Tectonics and Volcanism)
Geotechnical Eng.
Fluid dynamics and mod.
Radiochemistry
Metallurgy
Environmental Scientist

TABLE 2
WASTE MANAGEMENT BRANCH STAFF TECHNICAL EXPERTISE

ENCLOSURE 5

February 3, 1994

MEMORANDUM FOR: Bill M. Morris, Director
Division of Regulatory Applications

FROM: Mel Silberberg, Branch Chief
Waste Management Branch

SUBJECT: DIFFERING PROFESSIONAL VIEW ON RESOURCE SECTION OF RESPONSE TO STAFF REQUIREMENTS MEMORANDUM FROM HLW RESEARCH BRIEFING

My view of the impact of recent FTE reductions in the HLW program is not consistent with the final response to the subject SRM that I was asked to review for concurrence. Based on my thirty-five years of experience in managing research programs and my familiarity with both the complexity of the problem and the workload as well as the staff on board, it is my professional opinion that the last round of reductions (1.7 FTE) has taken the HLW research staff well below critical mass. It is intuitively obvious from a superficial examination of the attached material which I had prepared for the response but was not included. This intuitive conclusion is backed up by a close examination of available expertise and the associated workload necessary to maintain viability and productivity within the program. With the maturing of the HLW licensing and research programs through processes like the LARP and SRA, the network of activities involved in managing and coordinating this program have become much more visible. The figure in Enclosure 2 to the SRM is becoming widely accepted as description of this process and the shortfall in FTEs becomes apparent as you realize some of the arrows indicating information flow or input are staff intensive and cannot be implemented effectively at current staffing levels. There are no "smoking guns" but the gradual erosion of the staff's ability to successfully carry out their assigned responsibilities is more significant over the long run than any single high visibility incident.

I know of no other program in the Office of Research where funding has increased by 50% while research FTEs have dropped by about 25% except in the LLW research program. I have examined various ways of cutting back or getting some relief but everytime we take from one activity another suffers. I cannot in good conscience leave without expressing this view and making certain that its substance reaches the Commissioners who have asked the resource question. (I would also observe that the graphical and tabular information in the

enclosure to this memo have been provided to the NSRRC and I would think it prudent for the staff to provide the same to the Commission.) If the final SRM response goes forward maintaining that the current staffing level is tight but adequate, I request that this memorandum and the enclosure be included with the Commission Paper as a Differing Professional View.

/S/

Mel Silberberg, Branch Chief
Waste Management Branch

ALLOCATION OF RESOURCES

TO

THE HLW RESEARCH PROGRAM:

Resource levels, both dollars and FTEs, are assigned to the HLW research program in the course of the preparations for the agency's budget submittal. Targets are generally specified by the EDO and submittals are required to be written to the assigned budget level. Impact assessments are submitted for any change in budget level and are reviewed by all levels of management. In recent years there has been a gradual reduction in the number of FTEs

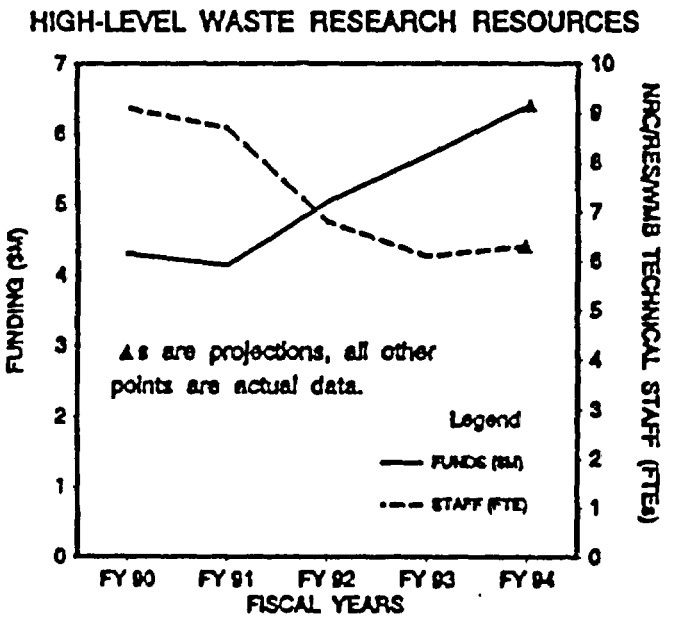

Figure 1

allocated to the HLW research program from 9 in FY 90 to 6.3 in FY 94, while the funding allocation has increased from $4.2M in FY 90 to $6.4M in FY 94 (Figure 1). The FTE decrease reflects 1) the elimination of one position that was dedicated to rulemaking because delays in projected regulation development reduced the need, and 2) elimination of a performance assessment specialist position and 70% of the waste management materials research position in reponse to ceilings imposed on RES FTE levels and competitive needs in the reactor research program. The increase in funding reflects the growth of the CNWRA to its fully funded and staffed level with the concurrent development of major research efforts in the area of tectonics and volcanism <u>without increased RES staff support levels</u>. Because of the 1.7 FTE reduction in these two areas, non-contract management activities of the staff such as technology transfer to NMSS, maintenance of staff skills, participation in inter-office performance assessment activities, corrosion modelling, assessment of

microbiological effects on corrosion, and support for NMSS initiatives such as the definition of Substantially Complete Containment have been all but eliminated. In addition, activities on tectonics and volcanism have resulted in reduced staff efforts on geochemistry in both the the HLW and LLW research programs.

Current planning calls for the FY 94 levels to persist through FY 96. The current program contains funding for all necessary NRC HLW research (with the possible exception of work on spent fuel for independent verification of DOE source term work) although some minor adjustments in funding levels may need to be made on a case-by-case basis to adjust to changing needs or opportunities. These levels are reflected in the High-Level Waste Research Program Plan (draft NUREG 1406).

Table 1 lists the currently staffed positions in the Waste Management Branch in the Office of Research, the expertise of the incumbent staff member, their principal assignments and the split of their time between high-level waste and low-level waste activities. Experience is not shown directly but all staff have been with the Commission, DOE, or State government working in earth science or waste programs for at least nine years.

Table 2 groups the above positions by expertise. At present, the mix of technical expertise is well matched to carrying out the curretn research program. Carrying out the HLW and LLW research programs in the same branch has in the past provided some flexibility in dealing with variations in work load. However, in the current environment where Waste Fund resources may only be spent on HLW activities flexibility only exists for activities which apply to either program. In addition, reductions in LLW staffing while the LLW budget for research has also increased in response to a national need has created a similar shortage of skilled talent in the LLW research program. Table 1 lists ALL RES staff involved in these two programs and their expertise and assignments in both programs because it is difficult to convey the nature of these programs and the staff workload as separate problems.

TABLE 1

WASTE MANAGEMENT BRANCH STAFF RESOURCES			
Staff Position	Expertise	Projects Managed	% HLW/LLW
Modelling Analyst	Simulation modelling of waste disposal systems. (MS in Physics)	High and low-level waste performance assessment methodology projects, LLW concrete barrier performance modelling; member of PAWG source term submodelling group; member of HLW IPA program.	85/15
Hydrogeologist	Evaluation of hydrogeologic systems. (MS in Hydrogeology, certified professional hydrogeologist (AIH))	HLW projects on stochastic methods and regional hydrology at CNWRA and Apache Leap field program and theoretical support project at U of AZ; LLW projects on stochastic methods, infiltration evaluation; grant with NAS on Fracture Flow and Fluid Characterization; Vice Chairman of INTRAVAL; representative to Federal Water Resources Research Committee; member of PAWG infiltration and hydrology submodelling groups.	60/40
Senior Program Manager	Fluid dynamics. (PhD in Mechanical Engineering)	Program Element Manager for all CNWRA research projects and manager of thermohydrologics project.	100/0
Geotechnical Engineer	Geotechnical engineering, performance evaluation of engineered systems. (MS in Geotechnical Engineering, licensed professional engineer)	HLW projects on sealing and seismic response of underground openings; LLW projects on durability of concrete and simulation modelling of concrete degradation; grant with NAS geotechnical board; representative to international DECOVALEX project; member of PAWG engineered system submodelling group.	70/30

WASTE MANAGEMENT BRANCH STAFF RESOURCES			
Staff Position	Expertise	Projects Managed	% HLW/LLW
Geochemist/Volcanologist	Geochemistry, volcanology, assessment of hydrothermal/geothermal systems. (PhD in Geophysics and Igneous Petrology)	HLW projects on volcanism in the Basin and Range, Field Volcanism, and Geochemical Analogues; LLW projects on bitumen and uraninite degradation in Oklo study; representative to NAWG Core Group and Oklo Steering Group; modelling of hydrothermal effects of dike intrusions.	90/10
Geochemist	Geochemistry, geology. (PhD in Geochemistry)	HLW projects on unsaturated mass transport, sorption mechanisms for modelling, contemporaneous deformation in the Death Valley Region, and tectonics of the basin and range; LLW project on transport processes at Alligator Rivers (follow-on work to ARAP project); integration of LLW geochemistry program.	90/10
Metallurgist	Chemical metallurgy, modelling of corrosion processes, microbiological corrosion. (PhD in Metallurgical Engineering)	HLW project on integrated waste package experiments, work on modelling of corrosion processes.	30/0
Radiochemist	Radiochemistry, radioactive waste forms, waste streams, water chemistry. (PhD in Chemistry and Nuclear Chemistry)	LLW projects on decontamination wastes, microbial degradation of waste forms, lysimeter studies, chelating agents, activated metals, and source term data for performance assessment; member of PAWG source term and air pathway submodelling groups.	10/90

WASTE MANAGEMENT BRANCH STAFF RESOURCES			
Staff Position	Expertise	Projects Managed	% HLW/LLW
Hydrogeologist	Hydrogeology, simulation modelling of hydrogeologic systems. (PhD in Hydrogeology)	LLW projects on source term modelling and field experiments for model testing; development and testing of performance assessment models for LLW PA; member of PAWG integration, infiltration and hydrology submodelling groups.	10/90
Acting Section Leader (Senior Geologist)	Geology, seismology. (PhD in Geology)	LLW projects on cover performance, retardation mechanisms in soils, kinetics of disequilibrium silicate weathering, and organic complexants and microparticulates; member of PAWG engineering submodelling group; representative to Yucca Mountain team meeting.	25/75
Section Leader (Environmental Analyst / Physical Scientist)	Physics, environmental engineering. (PhD in Nuclear Physics)	HLW project on overall research, management oversight of Branch PAWG activities.	60/40
TOTAL (FTE)			6.3/4.0

TABLE 2

DISTRIBUTION OF STAFF EXPERTISE BY PROGRAM*		
Expertise	HLW (FTE)	LLW (FTE)
Hydrogeology	.6	.9
Geochemistry	1.0	.2
Geology (Tectonics and Volcanism)	.8	0
Geotechnical Eng.	.7	.3
Fluid dynamics and mod.	1.95	.55
Radiochemistry	.1	.9
Metallurgy	.3	0
	5.45	2.85

*Section Leaders not included.