

October 28, 1996

Mr. John C. Hoyle
Secretary of the Commission
United States Nuclear Regulatory Commission
Attn: Chief of Docketing Service Branch
Washington, DC 20555-0001

Subject: Comments on Strategic Assessment Paper DSI 22, "Research"

Dear Mr. Hoyle:

In response to the NRC's request for comments on its Strategic Assessment Issue Papers, I am submitting comments on Paper DSI 22, "Research."

I have been in the Office of Nuclear Regulatory Research (RES) for over 15 years. Until February 1996, I was involved, in both staff and supervisory capacities, in RES's waste-management research program, working mainly on research to support the regulation of the disposal of high-level radioactive waste (HLW). In addition to the HLW research, I also had some staff and supervisory responsibilities for HLW and low-level-radioactive-waste (LLW) rulemaking and for research to support the regulation of LLW. I have several comments on RES's generic functions and activities and some comments on waste-management research.

Preference for Options

I support the Commission's preliminary views that the NRC should continue with a balanced program of confirmatory and exploratory research (Option 4), supported by a staff with the proper core capabilities (Option 5), complemented by the Educational Grant Program (Option 6), and coordinated with nuclear safety research programs in other countries (Option 7). RES currently operates just such a program in most areas where the NRC should be doing research and the approach being used is a good template for any regulatory research program.

Option 1, discontinuing the NRC's research program, is unacceptable for as long as the NRC needs new technical information to support its regulatory mission. The Energy Reorganization Act of 1974 very wisely established a separate NRC research office to take the long view of nuclear safety issues, ensure that the research needed to address those issues was done on time to meet the NRC's regulatory needs, and to ensure that regulatory decisions would not involve excessive conservatism.

Selecting either Options 2 or 3, conducting only confirmatory research or conducting only exploratory research, would result in the NRC's having an unbalanced research program. Under Option 2, the research might be overly reactive to licensees' activities and might be perceived as being designed *a priori* to support a licensees' actions. Under Option 3, the research might become irrelevant to the NRC's regulatory mission and needs.

The description of Option 6, "Having University Based Resources as a Component of the Overall NRC Research Program," implies that the only way that the NRC can support university research is through the Educational Grant Program. In addition to grant sponsorship, RES has supported highly successful university research under contracts and should continue to do so. The contracted research involving universities has been a balanced combination of confirmatory and exploratory research.

Paper DSI 22's Questions

The paragraph beginning with "A key factor" on page 13 of Paper DSI 22 poses several questions that need to be considered in deciding the future course of the NRC research program. I have restated these questions below and proposed answers for each of them.

Q: A key factor affecting effectiveness and efficiency is the role of the research office compared with the role of the program offices. For example, the Office of Nuclear Regulatory Research (RES) is often asked to assist the program offices in the review of issues to support specific regulatory decisions (technical assistance). The question arises as to whether such efforts should be performed by the program offices. On the other hand, should certain analyses performed by the program offices, such as thermal-hydraulic analysis, be performed only by RES?

A: RES should continue to provide technical assistance to the other program offices when such assistance is needed. The assistance gives RES an opportunity to participate in and gain a better understanding of the other program offices' regulatory issues. The assistance also provides RES with opportunities to put its products to work in the regulatory process.

Q: At present, most rulemakings are managed by RES. Should that continue, or should all rulemakings be assigned to RES, even though all rulemakings do not involve research, or should all rulemakings be assigned to the program offices?

A: This question is important enough to have a separate DSI paper dedicated to it. There are at least three options that should be considered:

1) Retain RES's current rulemaking functions. Adopting this option involves no effort but does not address the issue that other program offices now do some rulemakings of their own. To the best of my knowledge, there are no clear criteria for deciding whether RES or another program office will do a rulemaking.

2) Assign all rulemakings to the other program offices. The problem with adopting this option is that some rulemakings are generic and it may not be obvious with those rulemakings which program office should have the lead in developing them.

3) Establish a separate rulemaking office. This option is the one that I prefer. The NRC had a separate rulemaking office, the Office of Standards Development, until 1981. That office was then dissolved and absorbed by RES. Although rulemaking activities were initially dispersed throughout RES, they eventually were concentrated mainly in RES's Division of Regulatory Applications. I believe that this gradual separation of rulemaking functions from research functions within RES took place because rulemaking and research are very different activities and their managerial requirements are very different. With the exception of RES/DRA's Waste Management Branch, which is a research branch, all of RES/DRA's activities are rulemaking activities, and RES has already effectively separated much of its rulemaking work from its research work.

If the NRC were to have a separate rulemaking office with activities that need research support, RES could provide the support just as it now provides research support for material and reactor regulation.

Q: What RES functions, if any, could be performed more efficiently and effectively by the program offices? Should the overlap in some technical disciplines (e.g., thermal-hydraulic and severe-accident analysis, mechanical engineering, PRA, and

human factors) continue to exist between RES and the program offices to provide "office-dedicated" expertise, or should these be partially or completely merged to maintain a critical mass as a result of decreased resources?

A: RES should be doing research to support the regulatory activities of the other program offices and should not be involved in the other program offices' day-to-day interactions with material and reactor licensees and applicants. If RES's work is research-oriented, the overlap in technical disciplines would be disciplinary but not functional. For example, research involving experimental and theoretical work on thermal hydraulics should be done in RES and the application of thermal hydraulics analytical tools to reactor regulation should be done by the Office of Nuclear Reactor Regulation (NRR). With this division of labor, both offices need expertise in thermal hydraulics and the thermal-hydraulics functions carried out by the two offices will not overlap.

Q: What should be the role of RES compared with that of program offices in staying abreast of national and international nuclear safety developments, emerging technologies, and design concepts?

A: RES should have the lead NRC role in the NRC's dealings with other countries' nuclear safety research programs. The other program offices should have the lead on licensing and pre-licensing matters, for example in the provision of technical assistance to other countries on how to regulate radioactive waste disposal.

Q: Budget reductions have been so severe that all HLW research activities in RES are under consideration for transfer to NMSS [the NRC's Office of Nuclear Material Safety and Safeguards]. Even though such a decision would permit economies, is it possible that research issues will be explored in a more limited way because of licensing concerns or pressures?

A: While it is strictly true that RES still has a small HLW effort, most of what was left of HLW research after severe FY 1996 budget cuts, i.e. all remaining HLW research to be done by the Center for Nuclear Waste Regulatory Analyses, was transferred to NMSS early in CY 1996. Based on feedback that I have received from CNWRA employees, there is now essentially no HLW research left at the CNWRA. The answer to the question posed is "Yes, is it possible that research issues will be explored in a more limited way because of licensing concerns or pressures," and in fact it may end and that is what has happened at the CNWRA.

Q: [The HLW example above] raises a broader question for the entire research program if it were to be decentralized. Could the NRC attract and retain top research talent, and would research of a broader/exploratory nature be pursued with the research program components embedded in licensing organizations? If not, would that fundamentally impact the ability of the NRC to fulfill its health and safety mission given where the regulatory programs are today? Would the research budget be smaller and more efficient if managed by the licensing organizations? Would the absence of an independent research office result in lower quality research, absent a healthy technical debate between RES and licensing organizations over research applications and approaches?

A: (This question should have been posed as one of the options in Paper DSI 22.) The job of NMSS and NRR is, quite properly, to address and react to licensing concerns and pressures. Many of the activities of both offices are of a short-term nature because the licensing concerns and pressures require quick responses. While these

activities are essential to the NRC's mission, managing them is not compatible with managing research, which is a long-term activity. If NRR and NMSS manage NRC safety research, I believe that the research will die. For as long as the NRC needs new technical information to support its regulatory mission, there should be a separate research office to manage it.

Waste-Management Research

Paper DSI 22 presents an informative summary of the history of NRC reactor research, describes some of the research's products that have become useful in the NRC's regulatory activities, and describes international programs and agreements involving the reactor research. The discussion of waste-management research, by comparison, is perfunctory, and in some respects inaccurate. Since the mid 1970s, the NRC has done research on the safety of LLW and HLW disposal. There also was an NRC uranium mill tailings research program that was terminated in 1985. As was the case with reactor research, waste-management research also has gone through several phases throughout its history. The following descriptions of the NRC's waste management-research programs provide material that I believe should have been part of Paper DSI 22.

Low-Level Radioactive Waste Research

Early NRC LLW research in the mid 1970s examined LLW disposed in the ocean. Later, with the promulgation of 10 CFR Part 61 in the early 1980s, emphasis changed to research on the safety of shallow-land burial. Much research on groundwater flow and radionuclide transport in unsaturated soils was done during this period. In the late 1980s and early 1990s, as it became apparent that many states and compacts responsible for LLW disposal were going to use engineered disposal facilities rather than shallow-land burial, the NRC LLW research emphasis expanded to include the examination of the safety of engineered LLW disposal systems. Research on concrete barriers to LLW release, high-integrity containers for LLW, and the performance of LLW facility covers was done during this period. An LLW performance assessment methodology, implemented as part of an environmental decision support system at Sandia National Laboratories, also evolved with the LLW research. The applicability of the decision support system is now being extended to decommissioning.

After FY 1994, NMSS reduced its LLW regulatory program because the states and compacts responsible for disposing and regulating LLW had expanded their regulatory programs. Correspondingly, the supporting NRC LLW research has been phasing out some of its components and converting the applicability of others to decommissioning. Paper DSI 22 states erroneously that the staff and Commission have agreed that the LLW program is phased out. Paper DSI 5, the NRC's Strategic Assessment paper on LLW, describes NMSS's current LLW program and states that the Commission would like to restore the NRC LLW program to its FY 1994 levels. The restored program would have a research component. In my comment on Paper DSI 5, I recommended that, if the NRC continues with its current LLW program, that program should be augmented with an NRC LLW research program that serves the needs of state and compact regulators. I strongly recommend that RES manage any future NRC LLW research.

High-Level Radioactive Waste Disposal

When the NRC HLW research program began in the mid 1970s, the Department of Energy, the HLW licensee, was considering HLW disposal in bedded salt. The early NRC HLW research program began with the development of a performance assessment methodology for assessing the safety of HLW disposal in bedded salt. Toward the end of the 1970s, DOE began to consider HLW disposal in saturated fractured basalt. Concurrently with this development, the NRC was developing its HLW regulation, 10 CFR Part 60. Part 60 set the framework for all future NRC

HLW research.

In the late 1970s and early 1980s, projects on waste package failure, release of radionuclides from HLW waste forms, and groundwater flow and radionuclide transport in saturated fractured rock were initiated. The waste package and waste form programs concentrated on the effects of the chemically reducing environment in saturated geologic media. The development of a second performance assessment methodology, building on the one developed for salt but applicable to HLW disposal in basalt, was begun.

In the early 1980s, DOE also began considering disposing HLW in unsaturated tuff at Yucca Mountain, NV, which is still being characterized today. In 1981, the NRC initiated a project on groundwater flow and radionuclide transport in unsaturated fractured rock. Correspondingly, the NRC's waste package and waste form research programs were gradually expanded to include investigations of the effects of the chemically oxidizing environment in unsaturated geologic media.

In 1987, DOE was instructed by law to restrict its HLW activities to the Yucca Mountain site. The NRC HLW research program then phased out all saturated-zone work and work after 1987 concentrated on HLW disposal in the unsaturated zone. Due to the unique geology of Yucca Mountain, the NRC HLW research program added new projects on the effects of volcanism, tectonics, and seismicity on the stability of the geology and engineered excavations of the Yucca Mountain site. Fortunately, the development of the performance assessment methodology for HLW disposal in saturated basalt was essentially finished in 1987 and work began in earnest in 1988 on a performance assessment methodology in unsaturated tuff. By FY 1991, the NRC HLW research program had produced a useful performance assessment methodology for unsaturated tuff and this methodology was used in the NRC's HLW Iterative Performance Assessment effort described in NUREG-1464.

Beginning in FY 1988, with the advent of the CNWRA, the NRC gradually phased out all of its HLW projects at the National Laboratories and most other contractors and concentrated its HLW contracting at the CNWRA. By FY 1991, the only HLW research projects not at the CNWRA were at the University of Arizona. The CNWRA needed about three years to develop the appropriate staff and knowledge of the NRC's HLW program to become a full participant in the program. From about 1991 through FY 1995, the CNWRA conducted a vigorous and widely respected HLW research program on the NRC's behalf.

In FY 1996, the entire NRC HLW program was cut in half. The NRC restructured its HLW program to address key technical issues and a prioritization exercise was held in the last quarter of CY 1995 to decide what would be done under the new KTI framework. In early CY 1996, the management of the research components of the HLW work needed to address the KTIs and to be done by the CNWRA was transferred from RES to NMSS. The only remaining HLW research managed in RES is hydrology research at the University of Arizona, and that research is scheduled for termination in FY 1997. My understanding, based on discussions with CNWRA employees, is that little or no HLW research is now being done by the CNWRA.

Whether the NRC will reactivate its HLW research program depends partly on whether the national HLW program will continue to include definite plans for geologic disposal. In my comments on Strategic Assessment Paper DSI 6, on HLW and spent fuel, I recommended that, if the NRC has to regulate HLW disposal, it should restore at least the experimental components of its HLW research program to strengthen the technical basis of its HLW regulatory program. If the HLW research program is reactivated, I strongly recommend that RES manage it.

International Cooperation

The NRC waste-management research staff has incorporated international research results into the agency's licensing program and has participated in international projects of major potential benefit to the NRC. The NRC has cooperated in research through: (1) international agreements with Australia, France, Japan, Sweden, and Switzerland; (2) the International Transport Validation Project, INTRAVAL, and its predecessors, INTRACON and HYDROCON, managed by the Swedish Nuclear Power Inspectorate (SKI); (3) the Commission of the European Communities' Natural Analogue Working Group; (4) a natural analogue project operated by the Organization for Economic Cooperation and Development at Alligator Rivers, Australia; and (5) the multi-national DECOVALEX project (International co-operative project for the DEvelopment of COupled models and their VALidation against EXperiments in nuclear waste isolation), also managed by SKI. The NRC HLW performance assessment methodologies have been adopted in several other countries. A project to study seismic transfer functions and seismic effects on groundwater and underground openings was jointly funded by the NRC and the French Atomic Energy Commission (CEA) at Garner Valley, California. NRC and CEA staff are examining data from a natural analogue site at Oklo, Gabon. The NRC waste management-program initiated a joint effort with SKI to develop a strategy for testing and assessing performance assessment models. Natural and archaeological analogue projects operated by the CNWRA at Peña Blanca, Mexico, and Akrotiri, Greece, were conducted with the cooperation of Mexican and Greek authorities to examine surrogates of HLW geologic repositories. Volcanism projects operated by the CNWRA involved field work in Mexico, Nicaragua, Colombia, and Russia and required extensive cooperation with personnel in those countries.

Thank you for this opportunity to comment on the NRC Strategic Assessment effort.

Sincerely,

John D. Randall