

THE NUCLEAR REGULATORY COMMISSION'S FEDERALLY FUNDED RESEARCH AND DEVELOPMENT CENTER FOR THE HIGH-LEVEL WASTE DISPOSAL PROGRAM: THE CENTER FOR NUCLEAR WASTE REGULATORY ANALYSES

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ABSTRACT

The U.S. Nuclear Regulatory Commission (NRC) has established a Center for Nuclear Waste Regulatory Analyses (CNWRA or Center) to perform research and provide technical assistance to support its long-term (decades) responsibilities in licensing a high-level radioactive waste repository. The Center is a special-category government contract (Federally Funded Research and Development Center (FFRDC)) designed to preclude conflict-of-interest and assure continuity of services beyond the statutory five-year tenure of private-sector contracts. It is chartered to work only on the high-level waste (HLW) program for the U.S. NRC. The Center's scope includes the application of all earth sciences, engineering, legal and information management disciplines relevant to repository siting and design, transportation, QA/QC, performance assessments, regulatory requirements analyses and confirmatory research. The Center is established at the Southwest Research Institute in San Antonio, Texas with a core staff of 29 (60 to be hired by 1991) and with requisite operations plans; QA Manuals and management information and control systems in place. Research has begun in the areas of waste package corrosion, seismic effects on underground structures, geochemistry and hydrology. Major studies have begun on regulatory requirements and uncertainty resolution strategies and on transportation risks. Transfer of technology (e.g., computer codes and documentation, reference libraries) from former NRC contractors is underway. The Center is tasked to assist NRC staff in its critique of the Site Characterization Plan for the Yucca Mountain, Nevada repository site.

INTRODUCTION

The Nuclear Regulatory Commission broke with its contracting tradition in October 1987, when it decided to consolidate its high-level waste technical contracts, normally obtained through the private sector and the DOE national laboratories, in a Federally Funded Research and Development Center called the Center for Nuclear Waste Regulatory Analyses based in San Antonio, Texas. The purpose of this paper is to describe this new center-of-excellence in the High-Level Waste Program; explain the Center's scope, function and responsibility; describe briefly Fiscal Year (FY) 1988 accomplishments and FY89 objectives; and demonstrate to the waste management community that the Center is functioning and growing.

NEED TO DEVELOP A FEDERALLY FUNDED RESEARCH & DEVELOPMENT CENTER

The need for a change in the traditional practices of procuring technical services arose from the Nuclear Waste Policy Act (NWPA) (1) which established an extraordinarily long development, pre-licensing and licensing process (estimated to be 20-25 years). Special problems are posed in two critical areas: 1. Conflict of Interest. A number of NRC contractors were competing for winning larger contracts from the Department of Energy's (DOE) Civilian Radioactive Waste Management program (licensee); some NRC contractors were DOE laboratories; both situations created a potential for conflict of interest (real or perceived); and 2. Continuity of Technical Assistance and Research. Federal procurement policy requirements limit the contracting period of performance to five years; an assessment of the competitive market would be required at each five-year period, requiring possible re-competition; thus, the very long-term continuity needed in technical assistance and research is not assured. These special problems threatened

the credibility and continuity of NRC's technical program, which in turn jeopardized NRC's ability to complete its three-year statutory requirement for licensing a high-level waste repository. To resolve this problem NRC became the sole sponsor of the CNWRA, a Federally Funded Research and Development Center which is free of conflict of interest (both real and perceived) and which will ensure long-term continuity in technical expertise.

To begin to understand the special nature of the Center in the national program, one needs to know that a FFRDC is unique and its sponsor incurs certain substantial obligations. A summary of these characteristics is as follows (2,3).

Unique characteristics of a FFRDC are:

- It must be managed as a non-profit autonomous unit;
- It must remain free from conflict of interest;
- Its long-term relationship must be to the sponsor and evidenced by specific agreement; and
- Its charter limits its functions to the sponsor's specific needs.

The responsibilities and obligations of the FFRDC sponsor are (2,3):

- It must develop a long-term special relationship
- provide continuity, i.e., continuous long-term contractual arrangements
- attract high quality personnel, i.e., provide meaningful work and supplementary motivational imperatives
- It must assure continuity in level of support, i.e., annual budgets should not disrupt operations significantly
- must control access to the FFRDC by third parties

It must provide upper management oversight, i.e., guidance and appraisal of performance

It must provide sufficient government technical expertise, i.e., technical direction must be given, technical quality and defensibility of deliverables must be assured by the sponsor the user organization

PROCUREMENT AND CONTRACTUAL CONSIDERATIONS AND STATUS

The contract establishing the CNWRA at Southwest Research Institute (SwRI) in San Antonio, Texas, was executed on October 15, 1987. A cost plus award fee contract was deemed most appropriate to provide motivation for excellence in such areas as responsiveness, quality, timeliness, technical ingenuity and cost effective management over the long term in a non-competitive environment.

The requirements and considerations for awarding the contract are summarized from the Request for Procurement Action (4) as follows:

Mandatory Requirements

- Offeror had to clearly demonstrate the ability to provide the offices, facilities and equipment necessary to support the Center's missions
- Offeror had to clearly state a commitment to create the center as a non-profit concern outside the control of any profit seeking concern

Special Considerations for Award

- Technical and management criteria were of equal importance, followed by cost
- Primary emphasis placed on the offeror's ability to form, establish, staff and sustain the Center based upon:
 - Source, type, and experience of personnel
 - Form and structure of the physical facilities
 - Ability to ensure continued technical interchange
 - Ability to attract high-level professional staff
 - Management approach ensuring long-term continuity of excellence devoted to NRC's needs
 - A thorough understanding of the technology and scientific and engineering disciplines required

ORGANIZATION OF THE CENTER

The Center is organized to perform technical assistance and research in support of NRC's licensing and regulation of the high-level waste program. The basic concept of organization is a matrix of six technical program elements, each with a key person in charge, able to direct a task group with support from the Washington, D.C. office and from scientists and engineers (including subcontractors and consultants) under common control of a Technical Director acting in concert with a systems engineering and integration

group (5). The organization chart for the Center is shown in Fig. 1.

SCOPE OF WORK OF THE CENTER

The Center shall provide the personnel, materials, equipment, facilities, and other services necessary to conduct technical assistance and research for NRC in support of its regulatory program as related to activities under the NWPA (1) and Nuclear Waste Policy Amendments Act (NWPAA) (6) for a high-level radioactive waste disposal system (includes high level waste storage, transportation and disposal; and Section 151 activities concerning low-level waste). Specifically, technical assistance and research shall be furnished in support of NRC's development of regulations, regulatory guides, regulatory review methodologies and staff technical positions; special analytical studies; systems engineering; review of the DOE high-level waste program, which would include review of DOE documents, attendance at meetings between DOE and NRC, and participation in site visits; development of the capability to review a license application; and the providing of expert witnesses during NRC licensing hearings (4).

MAJOR PROGRAM ELEMENTS AND WORK CATEGORIES OF THE CENTER

NRC has pre-arranged to provide its specific technical directions to the Center in six major categories or program elements of work. Each program element has an element manager at the Center and a counterpart at NRC. Each of the elements has an annual budget and tasks described in an Operations Plan. The individual Program Element Operations Plans control the resources available, timing, level of effort and level of detail for each task or subtask. Subcontractors and consultants are available to support each element, on an as needed basis. Such experts are employed by the Center and are subject to the same conflict of interest and other requirements geared to achieve objectivity and independent judgments as the Center itself.

A summary of task areas in each program element is as follows (4):

Waste Systems Engineering and Integration and Overall Program Activities

Work under this area may include, but is not limited to: (a) systems engineering and integration applied to the total high-level waste disposal system and subsystems, from NRC's regulatory perspective; (b) performance assessment of repository systems; (c) technical review of other NRC contractor activities and other external-NRC activities pertaining to the waste program under NWPA/NWPAA and utilization of the results of other NRC contractor activities involving high-level waste; and (d) provide support to NRC in implementing its requirements for a licensing support system to meet the legal requirement for the Discovery phase and hearings (DOE will actually procure the system) and its Open Item Management System which is intended

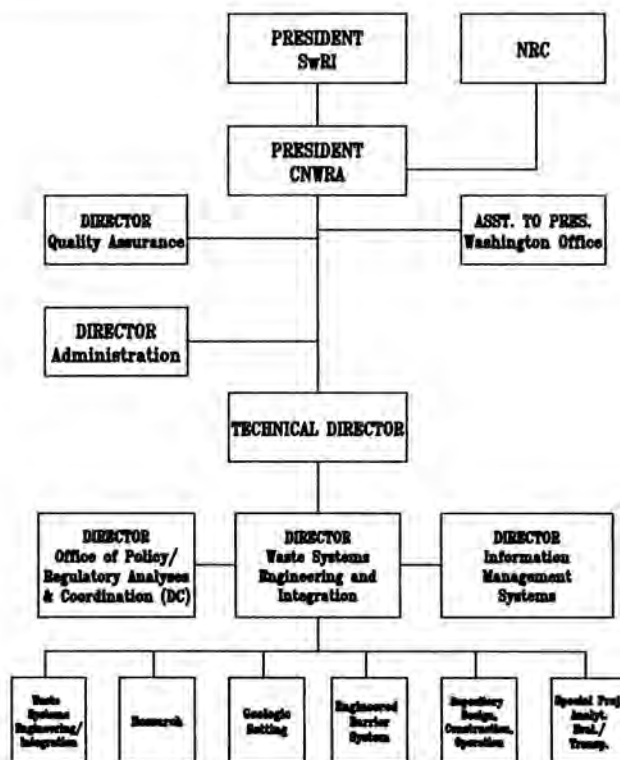


Fig. 1. Organizational Chart of the Center for Nuclear Waste Regulatory Analyses.

to identify, track, and document (to resolution) all potential licensing issues.

Research

Work under this area may include but not be limited to development and conduct of a Research Program based on a Systems Analysis to identify the Research Program that offers the greatest promise to reduce uncertainties in the High-Level Waste Regulatory Program. Such a Program will consider the ongoing Research Program of the DOE, State and other parties as well as the Regulatory Program of the Nuclear Regulatory Commission.

Performance of the Geologic Setting

Work under this area may include, but is not limited to, the review and evaluation of technical issues associated with the near-term and long-term isolation of the geologic setting of a repository and the siting of a monitored retrievable storage (MRS) system. Tasks would encompass earth science areas such as surface water hydrology, saturated and unsaturated groundwater hydrology, geomorphology, seismicity, geophysics, stratigraphy, structural geology, geochemistry, solute transport, and natural resource analysis.

Performance of the Engineered Barrier System

Work under this area may include, but is not limited to, the review and evaluation of technical issues and design considerations associated with long-term isolation and containment of the engineered barrier system of a geologic

repository and the siting of an MRS. Tasks would encompass areas such as nuclear engineering, mechanical engineering, mining engineering, materials science, corrosion engineering, manufacturing technology for metal and ceramic processing and geochemistry. Review and evaluation of adverse thermal and environmental conditions may also be required.

Repository Design, Construction and Operation

Work under this area may include, but is not limited to, the review and evaluation of technical issues and design considerations associated with the licensing, construction, and operational performance of an MRS and a high-level waste geologic repository. Tasks would encompass areas such as facility design, radiation protection, safety analysis, criticality, fire protection, process engineering, effluent treatment analysis, structural analysis, geotechnical engineering, and industrial and mine safety.

Special Projects, Analytical Evaluations/Transportation

Activities under this area may include, but are not limited to, the review and evaluation of selected DOE plans and reports; technical feasibility assessment; policy, transportation, environmental, socio-economic, institutional and legal analyses applied to NWA waste management issues; and strategic planning studies, including analyses of alternative approaches. Development of the Center's internal quality assurance (QA) program; assistance to NRC in the development of QA requirements for the waste disposal system and assessment of DOE QA program development

are monitored by NRC under this program element. However, these activities are carried out by the Center's QA Director who reports directly to the Center President.

FIRST YEAR CENTER REQUIREMENTS/ ACCOMPLISHMENTS

The start-up and planning activities of the Center were emphasized during its first year. Therefore, a concerted effort was made in Year 1 to curtail the rate of buildup relying principally on NRC staff and existing contractors for technical assistance work and existing research projects. During the first year, the CNWRA was required to address the physical aspects of implementing the Center; establish an effective organizational structure identifying roles, responsibilities, and applicable management and control techniques; develop technical and analytical capabilities including the initiation of a research program; and begin the development of the Program Architecture (described below) and the Program Architecture Support System (7).

The Center has been growing and developing as expected. Permanent office facilities which will accommodate planned growth of the core Center staff through FY91 have been established in San Antonio, Texas. A small CNWRA office has also been established in the Washington, D.C. area.

An eleven-man management team competent in the earth science and engineering disciplines applicable to deep geologic disposal of high-level waste was immediately hired upon execution of the contract. The Center's management has been engaged in learning the HLW program and coming to an understanding of exactly what NRC must accomplish to meet its statutory mission, and to secure the high-quality technical expertise in the appropriate disciplines. Although this learning process continues, significant insights were gained and a substantial increase in technical staffing was accomplished. By the end of FY89, the Center had 29 core staff members on board. Additional effort was supplied by SwRI staff, consultants and subcontractors. The Center used three subcontractors during the first year, ITASCA Consulting Group, Inc., Nuclear Waste Consultants, Inc., and Systems Support, Inc.

By the end of the year, the Center's management and technical staff had completed the preliminary design of the Program Architecture and developed and demonstrated a computer software support system to store and process the data developed for the Program Architecture. The Center, through its task of developing a "program architecture", supports a systems engineering analysis process of identifying, quantifying, and obtaining early resolution of technical, regulatory and institutional uncertainties in support of NRC's regulatory program. The entire life cycle of the repository which includes site characterization, construction, operation, operation monitoring, closure and decommissioning and post-closure monitoring will be addressed. This systems engineering process will result in the design of a system which will, in a timely manner, identify and provide recommendations and alternative solutions to technical, regulatory and institutional uncertainties prior to submission of DOE's initial license application, thus streamlining

the licensing process and facilitating the implementation of the NWPA and the NWPA.

The analyses which have and will continue to be conducted are focused on identifying each regulatory requirement, its elements of proof (what is to be proven), the compliance demonstration methods by DOE and compliance determination methods by NRC. The lack of certitude about what the regulation requires and what technical and institutional limitations exist will also be assessed and the Center will recommend technical programs and priorities to reduce the uncertainties to an acceptable level. Finally, the system will reflect the NRC decisions regarding recommended technical programs and priorities. Once the decisions have been made on the uncertainty reduction methods, the system will include the corresponding specifics for NRC's Format and Content Guide and Standard Review Plan keyed to each regulatory requirement.

In June 1988, the Program Architecture development was accelerated. The Center was directed to concentrate on those regulatory requirements that pertain to siting and to produce, to the extent practicable, interim products to assist the NRC management and staff in meeting the programmatic production schedule for site characterization analyses and rulemakings. During the first year, the Center also started work on four research projects in the following areas: (a) long-term degradation of waste package materials; (b) seismic effects on underground repository structures; (c) geochemistry aspects of radionuclide transport in the repository geologic environment; and (d) characteristics of thermohydrologic phenomena on the scale of the repository and of the waste-packages in unsaturated geologic media.

Technology transfer to the Center has also begun. For example, a computer code and the technology related to the code, which were previously developed by an NRC contractor, were transferred to the Center. This code (CONVO), which is used to assist in assessing waste package performance, is now up and running on the Center's computer and is undergoing modification and further development by the Center.

Other first year accomplishments were the development of detailed "Operation Plans" which defined the specific deliverables, costs and schedules for Years 1 and 2; the development and implementation of a large number of management and administrative procedures; the initiation of a three-year transportation risk study; the preparation of a number of miscellaneous deliverables (e.g. the completion of three special studies: Analyses of NWPA; Possible Conflict of Interest in using the Bureau of Mines or U.S. Geological Survey in the Technical Evaluation of the Natural Resources Regulatory Requirement; and State of Knowledge in Waste Confidence) and the development of the Center Quality Assurance Manual which meets the requirements of 10 CFR 50 Appendix B as applicable and the NRC HLWM QA Standard Review Plan. The QA Manual goes beyond these requirements by including a

Decision Support System to enhance the quality of management discussions made at the Center (7).

SECOND YEAR CENTER OBJECTIVES

NRC originally envisioned a three-year phase-in plan for the establishment of the Center and the transfer of essentially all NRC technical assistance work from existing contractors. However, in Year 2 NRC decided to accelerate this plan and phase out nearly all of its existing contractors by the end of the second year of operation. The level of both proactive and reactive support will, therefore, increase throughout the second year. The Center will provide technical support to the NRC staff in the reactive area by recommending regulatory requirements that should receive priority attention during NRC's review of DOE's site characterization program, by assisting in NRC's review of DOE's Site Characterization Plan (SCP); by assisting NRC in resolving technical concerns raised in NRC's comments on DOE's CDSCP (such as those raised regarding the exploratory shaft); by assisting in quality assurance audits; and by providing technical support to the staff in developing Technical Positions and assessment capability (e.g. preclosure performance assessment strategy).

During the second year, the Center will continue to develop its technical and analytical capabilities, including planning activities and the hiring of additional technical staff. New hires are planned to increase total staffing from 29 to about 41 by the end of FY89. Emphasis will continue to be placed on the development of the Program Architecture. By the end of FY89, the overall Program Architecture will be developed to the point that it can be baselined. Further enhancements will be made in out-years under specified configuration control procedures. Also of interest is the scheduled delivery of an integrated research plan. This plan will recommend research necessary to reduce significant technical uncertainties identified during the course of the Center's Program Architecture development. The Center's recommendations will be considered with additional findings on research needs which may evolve from the NRC staff's development of its performance assessment capabilities.

The Center will continue work on the four research projects begun in Year 1, as appropriate. In addition, two

new research projects will be started late in FY89 dealing with flow and transport in unsaturated geologic media. The three-year transportation risk study initiated in Year 1 will also continue.

If the above expectations are met, the Center will be ahead of the original three year phase-in plan with regard to its ability to provide necessary technical support to the NRC (7).

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