



RESULTS OF THE FIRST NRC AUDIT
OF THE
HIGH-LEVEL WASTE REPOSITORY PROGRAM

James E. Kennedy
Section Leader
Division of High-Level Waste Management
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555

ABSTRACT

This paper describes the first NRC audit of the Department of Energy's high-level nuclear waste repository program. The audit was conducted at the Los Alamos National Laboratory (LANL) in June of this year. Los Alamos is performing laboratory investigations of the geochemistry aspects of the Yucca Mountain site in Nevada. This paper will discuss the differences observed by the NRC staff between auditing this first-of-a-kind exploration program and commercial power reactor design and construction programs. This paper will also discuss the results of the LANL audit.

INTRODUCTION

Within the next year or so, the Department of Energy (DOE) plans to conduct extensive site characterization activities for a permanent geologic repository at each of the three sites located in Texas, Nevada, and Washington. Because much of the data collected during this phase of the program will support the safety analyses in the license application to the NRC, these data need to be collected under a quality assurance (QA) program which is acceptable for licensing. The NRC requires the use of the nuclear power reactor QA criteria in Appendix B to 10 CFR Part 50, modified somewhat for data collection activities during site characterization.

This paper will discuss the first NRC audit of the DOE QA program for the geologic repository program and will focus on some of the unique aspects the staff observed in auditing a program which is largely exploratory in nature and therefore different from the engineered facilities the staff routinely audits.

QUALITY ASSURANCE IN THE HIGH-LEVEL WASTE REPOSITORY PROGRAM

To put into perspective DOE's quality assurance programs for the geologic repository and the first NRC audit of these programs, it is useful to examine the latest schedules and milestones established by the DOE in the



June 1987 amendment to the Mission Plan, which are shown in Figure 1. Initial waste emplacement is scheduled for the year 2003, at which time the NRC will, if the conditions warrant it, license the DOE for waste emplacement. Prior to that date, the DOE will have constructed the facility over a five year period. Before construction can begin, DOE is required to submit a construction authorization application to the NRC, currently scheduled for 1995. This application will provide detailed information on the site chosen for repository development and will demonstrate that the public health and safety and waste isolation criteria in the NRC's regulations have been satisfied. The present schedules contain a three year review period for this application by the NRC, about half of which is for staff review and the remainder for litigation in a licensing hearing. From now until the construction authorization, DOE will collect extensive site characterization data for each of the sites. In addition, DOE will develop designs for handling, emplacing, and isolating waste. The collected data will cover the disciplines of hydrology, geology, geochemistry, materials engineering and others. Many of the scientific investigations will be exploratory, first-of-a-kind, and one-of-a-kind, not the routine testing performed in nuclear power reactor facilities which are used to demonstrate that systems and components can perform their design functions.

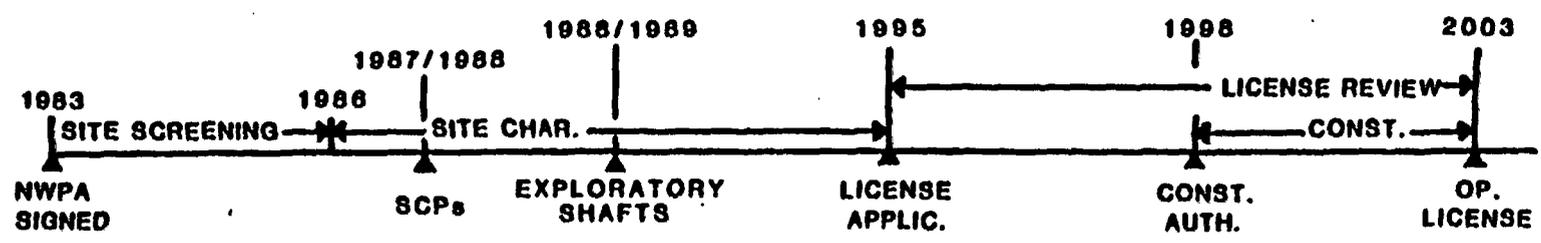
Because the data collected during site characterization will be the primary basis for the license application to the NRC, it is important that they be collected under a rigorous quality assurance program. The DOE is required by the regulations in Subpart G of 10 CFR Part 60 to have an Appendix B quality assurance program in place for site characterization activities. DOE has also committed to having a fully qualified quality assurance program in place at the time the site characterization plans (SCPs) are issued to help ensure that data and analyses will be found acceptable in the licensing review. In addition to these DOE actions, the NRC staff should have conducted sufficient oversight of the DOE QA program from the start of site characterization so that significant new issues will not be raised by the staff late in the program. At that time, collecting new data may not be possible, given the cost and delays in schedule which might result. To help prevent such an occurrence, the DOE has requested early NRC involvement through staff audits of its QA program. The audit conducted in June is the staff's first major step in assessing the implementation of the DOE QA program.

LESSONS LEARNED IN QUALITY ASSURANCE FROM THE POWER REACTOR PROGRAM:

One of the NRC objectives in the high-level waste repository program is to transfer as many of the reactor program lessons learned as possible. In response to a number of design and construction problems in nuclear power plants in the late 1970's and early 1980's, the NRC instituted improvements in its inspection and audit programs for nuclear power reactors.



MISSION PLAN AMENDMENT, JUNE 1987



DOE SCHEDULE -- FIRST REPOSITORY

Figure 1

FOURTEENTH ANNUAL NATIONAL ENERGY DIVISION CONFERENCE





These include the following which are applicable to auditing this program:

- o A greater focus on "end product." This concept requires that technical specialists be utilized on audit teams to examine the technical quality of designs, test plans and programs, etc., along with programmatic QA specialists who review the process by which these products were developed. This does not mean that only end products will be examined. Complete documentation is still needed to provide confidence in work performed. However, "process" should not be the sole focus of audits.
- o Examination of a "vertical slice" of the program to obtain an overall picture of the program effectiveness. For a power reactor, this means selecting a system or subsystem for detailed review, beginning with the highest level design criteria; tracing the translation of these criteria into drawings and specifications; and inspecting the installation of hardware in the plant. For the repository site characterization phase, this means the identification of performance objectives for the site and engineered barriers; identification of the data needed to determine if these objectives can be met; the development of test plans and procedures for data collection and analyses; and the analyses of these data to determine if the performance objectives have been fulfilled. This practice of examining a vertical slice is particularly effective in assessing the interfaces between organizations.

For the NRC's first audit in the repository program, it was not possible to review a vertical slice since only a limited portion of the work was determined to be ready by the DOE. The audit did, however, examine "end product," which in this case was the technical work and data collection activities of the LANL staff. Due to the nature of the site characterization program, there were several challenges in assessing the end product at LANL.

AUDIT OF LOS ALAMOS NATIONAL LABORATORY

Background

DOE is putting into place QA programs designed to meet the Commission's QA requirements in 10 CFR Part 60, Subpart G. In December 1986, DOE identified the first organizations whose QA programs were ready for NRC audit. Because the NNWSI project had a schedule for issuance of its site characterization plan which preceded the other sites, it was given priority over the other site programs suggested. NRC selected Los Alamos



because of the importance of its work in resolving some of the key site issues. It is also an organization where research activities are prominent, thus allowing the staff to determine how DOE was interpreting the QA requirements for this type of work. Los Alamos is one of the nine participating organizations for the Nevada Nuclear Waste Storage Investigations. It is responsible for nuclide migration studies, geochemistry, mineralogy, and petrology. Los Alamos also acts as the lead technical organization for the exploratory shaft (ES) which includes planning and design review for shaft construction, technical direction, and coordination and scheduling of the ES testing program.

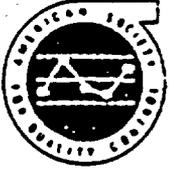
Within the overall Los Alamos program, the mineralogy/petrology studies of the Yucca Mountain site were the first to be ready for NRC audit. As described by the DOE, these studies will provide descriptions of rock and fracture-fill petrology and mineralogy along transport pathways to the accessible environment. The information gained will provide the basis for determining the timing and transport phenomena from past alteration, and for examining the geologic record of mineral stability. This information will also be used in determining whether the site can meet the waste isolation performance objectives defined in the Commission's regulations in 10 CFR Part 60.

Objectives of Audit

There were several objectives for this audit. The first was for the staff to independently assess the implementation of a selected portion of the DOE's QA program, examining both the programmatic aspects of the QA program and the quality of the technical work done under that program. Where applicable, lessons learned by the NRC staff from the reactor program were to be incorporated into this audit. Second, since DOE has never had a major facility licensed by the NRC, this audit was intended to be a calibration for them on the expectations of the NRC staff. Third, the NRC staff has never audited such a program of research and exploration and therefore expected to learn firsthand about the unique aspects of this program and to build a foundation for future auditing.

Method of auditing

The audit evaluated both the programmatic QA and the technical work being performed at LANL. The programmatic portion of the audit was conventional in nature and focused on compliance with the various requirements of Appendix B of 10 CFR Part 50 and the LANL QA plan and procedures. The technical portion of the audit, however, was different from similar evaluations used by the NRC reactor staff. The technical team, which consisted of staff and contractor geochemists who were reviewers for the NNWSI project, assessed the detailed technical procedures being used in the mineralogy/petrology program at LANL to determine if they reflected accepted scientific practice. They also



determined whether these procedures were being followed by the LANL staff.

The work activities performed at Los Alamos are different from those in designing and constructing a nuclear power reactor and these differences affect the auditing of the technical work within the program. Nuclear power plants have fairly prescriptive criteria in place in the NRC's regulations. These are supplemented by numerous Regulatory Guides and consensus standards such as those published by the ASME, ANSI, ACI and others. These standards define in detail the methods and criteria for reactor design and construction. In addition, numerous plants have been built over the years and a large body of practice has evolved in the architect/engineer organizations. All of these provide a well-established basis against which to conduct audits and to evaluate the quality of the technical work. The mineralogy/petrology studies at Los Alamos, on the other hand, are often first-of-a kind investigations. Many of the techniques for evaluating samples from Yucca Mountain are novel or state-of-the-art and the investigators at Los Alamos may be the only individuals intimately familiar with the techniques being utilized.

It is helpful to examine an example of the technical procedures being used at LANL to understand their nature and the difficulty in assessing their adequacy. One of the key analytical procedures used by LANL is the microprobe operating procedure. The electron microprobe is a standard tool for analyzing the chemical composition of mineral phases. The LANL procedure is a step by step description of how to bring the instrument into the analytical mode. Because various techniques will often be employed during the analysis of heterogeneous geological material, descriptions of how the procedure is best applied to the rocks of Yucca Mountain are not included in the procedure. The proper application of the procedure is therefore strongly dependent upon the knowledge and experience of the principal investigators.

Because of the unique nature of the work in the laboratory, and the lack of standards against which to evaluate the adequacy of that work, the technical team faced a particular challenge. In this particular case, the team members were familiar with the techniques utilized. It is expected that in some future audits in different technical areas the staff (and DOE) will need to rely more heavily on the judgments of expert peer reviewers who will assess the quality of work and thereby provide confidence that the techniques utilized are appropriate and the data collected from them valid and defensible. These peer reviews will substitute for the detailed criteria, standards, and practices developed over the years for the design and construction of nuclear power reactors.

RESULTS

As noted earlier, the audit conducted by the staff was divided into both a programmatic and technical assessment of the LANL program. The



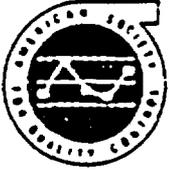
technical audit team had two general conclusions concerning the ability of the LANL technical staff to produce quality work using the existing detailed technical procedures for the NNWSI mineralogy/petrology program:

- o The LANL technical staff includes experts and specialists with extensive experience in the disciplines of mineralogy and petrology. The NRC technical audit team, after interviews with these scientists, is confident in their ability to perform quality work.
- o The detailed technical procedures are written in a non-specific form such that they may be applied by qualified technical personnel to various NNWSI investigations. Because of their general nature, the procedures alone will not guarantee quality analyses. However, the NRC technical audit team is confident that the current group of investigators can use the existing detailed procedures to perform quality analyses.

The staff also conducted a QA programmatic review which examined the implementation of the eighteen criteria in Appendix B to 10 CFR Part 50. The following are the main conclusions from that portion of the audit.

- o All of the necessary procedures were not in place. In addition, some portions of the existing procedures were not being followed.
- o Although an internal audit program was in place, it needs to be strengthened. Both DOE and NRC conducted audits soon after an internal LANL audit and detected deficiencies.
- o The documentation of the qualifications and training of personnel was incomplete. Although the team found no evidence that technical staff were not qualified for their positions, based on interviews conducted, the records in this area were not complete. This is particularly important for the NRC licensing process since the current work at LANL would not be challenged in licensing for another 7-8 years. At that time, some if not many of the investigators may no longer be working on the NNWSI project.

These audit conclusions can be corrected in the near future, thus enabling LANL to have a program meeting the Commission's quality assurance regulations. If the necessary corrective action is taken and the QA program is vigorously implemented throughout site characterization, the data collected would be difficult to challenge in licensing.



COMPARISON OF RESULTS WITH OBJECTIVES

As noted earlier in this paper, this audit had several objectives and it is worthwhile to examine each to determine how well they were fulfilled. The first was for the staff to independently assess the LANL QA program and decide whether it meets the Commission's QA regulations. The staff found that, although the program is in place, further improvements are still needed. Related to this first objective is the second, to calibrate DOE on the expectations of the staff. Based on the results, it appears that the staff expectations are somewhat higher than DOE's, at least within this portion of the DOE program. The NRC staff is better informed of the needs of the licensing process, and since neither DOE nor LANL has been through the licensing process, this observation is not unexpected. The third objective was for the NRC staff to build a foundation for future audits through its experience in the first one. After the audit, the staff consulted with DOE, LANL, and the State of Nevada about improvements it could make in the auditing process and these will be instituted as appropriate in future audits.

SUMMARY

The NRC staff recently conducted its first audit in the DOE high-level waste repository program. This audit was conducted at the Los Alamos National Laboratory which is performing studies for the Nevada Nuclear Waste Storage Investigations at Yucca Mountain, Nevada. The assessment of the technical work at LANL was different from conventional NRC audits and inspections which have detailed criteria against which to measure the quality of work. Although the audit team had confidence in the quality of the work at the conclusion of the audit, future assessments in other program areas may be more difficult. The staff will continue to perform technical audits, but will also monitor selected peer reviews within the DOE program which assess technical procedures and analyses.

The QA program at LANL was audited and several deficiencies identified which need to be corrected before it can be considered to meet the Commission's QA requirements.

NOTE TO ASQC PAPERS

- 2 -

OFFICIAL CONCURRENCE AND DISTRIBUTION RECORD

NOTE TO: M. Bell, DHLWM
J. Youngblood, HLOB
J. Kennedy, HLOB
B. Belke, HLOB
A. Duncan, HLOB
J. Donnelly, HLOB

FROM: L. Riddle, HLOB

RE: ASQC PAPERS

DATE: **OCT 05 1987**

DISTRIBUTION

HLWM/SF

NMSS RF

PDR

LRiddle & r/f

CONCURRENCES

ORGANIZATION/CONCUREE

INITIALS

DATE CONCURRED

HLOB/ LKRiddle



87/15

Originals sent 10/5

*792
746 70*