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REACTOR VS. REPOSITORY QA: WHAT'S THE DIFFERENCE?

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ABSTRACT

The NRC is revising the 1984 High-Level Waste (HLW) Quality Assurance Review Plan. In preparing the revision to Appendix A of the 1984 QA Review Plan, the staff recognized differences between reactor QA requirements and the QA needs for the site characterization program. This paper will discuss these differences and their effect on the revision to Appendix A.

INTRODUCTION

The quality assurance regulation for the geologic repository, 10 CFR Part 60, states that the quality assurance (QA) requirements should be based on the QA requirements for nuclear power reactors found in 10 CFR Part 50 Appendix B "as applicable and appropiately supplemented...." In preparing QA regulations for the repository, the authors of 10 CFR Part 60 determined that the reactor QA requirements contain guidance that is useful in developing the quality assurance requirements applicable to the repository program. The authors also recognized that some of the requirements may not apply to the repository and that the repository may require some additional guidance.

In 1984, the NRC issued the QA Review Plan for Site Characterization of High-Level Nuclear Waste Repositories. The plan's Appendix A addresses applicable reactor requirements and the needs for supplemental guidance. The authors of Appendix A modified the QA guidance found in Section 17 of NUREG-0800, the USNRC Standard Review Plan (SRP) for power reactors, so it could apply to the repository. The guidance in Appendix A has 18 criteria that correspond to the 18 basic criteria of 10 CFR Part 50 Appendix B and Section 17 of the SRP.

Currently, NRC staff is drafting a revision to the 1984 Quality Assurance Review Plan for Site Characterization. The revision will focus on Appendix A of the review plan in order to:

- reflect DOE's and NRC's three years of experience with Appendix A of the 1984 QA Review Plan for Site Characterization;
- incorporate lessons learned from the reactor program;
- endorse NQA-1, the industry standard QA guidance for nuclear facilities, where the guidance applies to the repository program;
- be consistent with the NQA-3 committee's supplemental guidance for site characterization;
- show that the guidance in Appendix A is traceable to specific requirements in 10 CFR Part 50 Appendix B; and
- write Appendix A so that persons other than QA professionals can understand it.

In reference to lessons learned, the Ford Study was completed in 1984 with the issuance of the NRC's NUREG-1055 entitled, "Improving Quality and the Assurance of Quality in the Design and Construction of Nuclear Power Plants." The Ford Study identified the causes of quality problems in the design and construction of nuclear power reactors and in the record keeping necessary to establish quality design and construction. The Ford Study also recommended measures that could be used to avoid these problems in the future. Thus, the Ford Study provided information and analyses that should be considered in the application of QA to the characterization of a high-level nuclear waste (HLW) repository.

Recently, the committee issued a draft national standard for the collection of scientific and technical information to be used in site characterization of high-level nuclear waste repositories. The NRC staff is working with the NQA-3 committee to maintain consistency in new QA guidance for the repository.

In order that the guidance in Appendix A is traceable to 10 CFR Part 50 Appendix B, the revision to Appendix A will be organized differently from the 1984 version. Appendix A will be organized such that each requirement of 10 CFR Part 50 Appendix B is listed with the corresponding guidance from NQA-1 and is followed by NRC staff positions and discussions, as necessary. As a result, the revised Appendix A will be based on Appendix B rather than on Chapter 17 of the SRP. In addition, the revision will contain definitions of terms used in Appendix B, NQA-1, and the staff positions. The definitions have several sources, including NQA-1. The new format will make the guidance easier to understand especially by those persons who are not experienced in QA or the licensing process.

The NRC staff does not anticipate that the revision to the 1984 QA Review Plan will significantly impact existing DOE QA plans. The revision clarifies the guidance in the 1984 version, documents matters discussed in meetings with DOE personnel, and incorporates guidance found in NRC generic technical positions and other documents. The NRC staff believes the proposed revision will aid the DOE in appropiately implementing the requirements for characterizing the geologic repository and will reduce the number of NRC concerns about existing DOE QA plans. One of the purposes of issuing the revision as a draft for public comment is to learn what impact specific changes will have on the DOE program and to determine if the changes are still needed given the impact.

In preparing the revision to Appendix A of the 1984 QA Review Plan, the staff recognized the similarities and differences between reactor QA requirements and the quality assurance needs for the site characterization program. The similarities include the shared goal: the achievement of quality and the ability to provide evidence of quality achievement. In addition, many of the QA requirements of Appendix B and NQA-1, including procurement and inspections, directly apply to the repository program. The differences between reactor QA and repository QA include:

- the timing of the programs,
- the differences in nuclear power reactor and geologic repository technical terminology, and
- the special needs of the repository.

DIFFERENCES BETWEEN REACTOR QA AND REPOSITORY QA

I. TIMING OF THE PROGRAMS

The reactor program has existed for many years and the nuclear industry and the NRC have accumulated valuable experience in the area of quality assurance. On the other hand, the repository program is just beginning, and DOE can draw upon this QA experience to the benefit of their program. As noted above, the Ford Study resulted in " lessons learned" that could be used to avoid quality problems in the design, construction, and record keeping of nuclear power plants. In the last few years, the nuclear industry and the NRC have applied these lessons successfully to nuclear plants, such as Vogtle. The lessons, however, came too late to be applied early in the design and construction process. In the repository program, the DOE has the opportunity to implement the reactor lessons in the early stages of the program. The lessons learned include:

- readiness reviews at important stages in the site characterization program;
- increased focus on end product rather than programatic issues; and
- a strictly implemented QA program.

The NRC staff will incorporate these lessons learned into the revision of the QA Review Plan. For example, the revision will emphasize that the QA organization is responsible for monitoring the technical work in order to verify that the quality assurance program is fully implemented.

II. TERMINOLOGY

The second difference between reactor QA and repository QA is that different technical terminology is used. The QA requirements in 10 CFR Part 50 Appendix B use reactor-specific terminology. As a result, the requirements are difficult to implement in the repository program. For example, Appendix B states:

> "Design control measures shall be applied to items such as the following: reactor physics, stress, thermal, hydraulic, and accident analyses; compatibility of materials; accessibility for inservice inspection, maintenance, and repair; and delineation of acceptance criteria for inspections and tests."

The repository does not include items such as reactor physics analyses. Thus, this requirement is difficult to implement in the repository program.

Authors of the 1984 version of Appendix A replaced reactor-specific terminology in Chapter 17 of the SRP with repository-specific terminology. The revision to Appendix A also will address this terminology problem. The revision will identify requirements in 10 CFR Part 50 Appendix B that are not applicable to the repository because they contain reactor-specific terminology. In addition, the revision will substitute repository terminology where appropriate. The staff will use the same substitutions that the authors of the 1984 version used where appropriate. For example, the revision will indicate that the requirement noted above is not applicable because of the reference to reactor-specific items. Then, the revision will indicate that design control measures should be applied to items important to safety or waste isolation.

III. SPECIAL NEEDS OF THE REPOSITORY PROGRAM

The third difference between reactor QA and repository QA is the need for some special QA guidance in the repository program. The site

characterization stage of the repository program will include scientific investigations that will produce data on the natural conditions existing at the site. The DOE will use this data and existing data in the performance assessment to determine if the site can meet the performance objectives set forth in 10 CFR Part 60. To ensure that the performance assessment is representative of the site, DOE should thoroughly plan the scientific investigations so that they will explore all important aspects of the natural systems. In addition, DOE should control the conduct of scientific investigations so they are conducted properly. Finally, DOE should control data and data analyses. If the scientific investigations and data are not controlled, DOE risks having insufficient evidence for the license application. The requirements in 10 CFR Part 50 Appendix B and the guidance in NQA-1 do not specifically address areas in the site characterization process such as the control of plans for or the conduct of scientific investigations and the control of existing data or collected data. Therefore, the requirements in Appendix B need to be supplemented in these areas.

In revising Appendix A of the HLW QA Review Plan, the NRC staff will evaluate the requirements in Appendix B of 10 CFR Part 50 to determine if they apply to site characterization. Where additional guidance is needed, the NRC staff will supplement the requirements based on the 1984 version of Appendix A, the work of the NQA-3 committee, and the NRC generic technical positions.

A. Scientific Investigations

The first example of an area in need of additional guidance is scientific investigations. There has been a lot of discussion about the application of requirements in Appendix B to to the plans for and conduct of scientific investigations. Initially, the NRC staff reviewed 10 CFR Part 50 Appendix B and believed that requirements for test control would apply. After working with the requirements, the staff found that this is not the case for many scientific investigations. The first requirement for test control in 10 CFR Part 50 Appendix B provides a good example. The requirement states:

> "A test program shall be established to assure that all testing required to demonstrate that structures, systems and components will perform satisfactorily in service is identified and performed in accordance with written test procedures which incorporate the requirements and acceptance limits contained in applicable design documents."

In order to fully understand the meaning of this requirement, the words, "test," "demonstrate," and "accceptance limits" must be defined.

A dictionary defines "test" as a critical examination, observation, or evaluation. Many scientific investigations fit this definition. In the

reactor program, however, workers use "tests" to demonstrate that an item will perform satisfactorily in service. Workers conduct tests on structures, such as the containment building; on systems, such as cooling systems and electrical systems; and on components such as valves, electrical motors, pumps, etc. These tests actually simulate the physical, chemical and environmental conditions to which the structure, system, or component would be subjected following the item's installation or during the plant's operation. In order to test some items, you need elaborate setups with strictly controlled conditions.

The use of testing by the nuclear reactor community also has affected the meaning of the word, demonstrate. Tests have been used as evidence in licensing hearings to demonstrate that the structures, systems, and components of a nuclear plant are suitable for use in plant design. Recently, I attended a meeting concerning the Generic Technical Position on the Q-List. The use of "demonstrate" in this position became a topic of discussion. The sentence in question read:

> "For example, at the SCP stage, all site characterization activities should be considered to be within the scope of the 10 CFR Part 60 Subpart G QA program, unless DOE can demonstrate they are not potentially related to items important to safety or waste isolation."

Staff members not experienced in the use of the word "demonstrate" in the licensing context expected that the authors of this statement intended that DOE provide a written explanation of why the activities in question are not potentially related to items important to safety or waste isolation. Other staff members with reactor licensing experience, however, were quite concerned that this statement required DOE to set up elaborate tests to show that the activities were not related to items important to safety or waste isolation. In this case, it would be nearly impossible for DOE to establish these tests. In light of the special meaning imparted to the word "demonstrate" by the licensing process, the concerns of certain staff members are more easily understood. As a result, the NRC staff is rewording the generic technical position.

The requirement noted above also indicates that acceptance limits are contained in design documents. The design of man-made structures, systems, and components establishes limits on the performance of items. In tests, the item is expected to perform within these limits. Thus, the test will ensure that the item meets these performance limits. On the other hand, many scientific investigations determine unknown characteristics of the natural environment. They may be conducted on rocks, subsurface fluids, and surficial tectonic features. The rocks, fluids, and tectonic features, however, will not be accepted or rejected.

In contast to tests, many scientific investigations do not simulate the operating conditions of the repository; they do not demonstrate that the

item tested will perform as designed; and they do not determine if the item tested meets acceptance limits. The scientific investigations will result in numerous data and models that together will be used to determine if the geologic, hydrologic, and geochemical systems will meet the performance objectives outlined in 10 CFR Part 60. Direct testing will not give rise to this determination in the same way that the testing of reactor structures, systems, or components leads to their acceptance. The determination that the natural systems meet the performance objectives will result from measurements of natural characteristics, sound scientific interpretations of these measurements, and the use of performance assessment. A physical model of the repository natural systems, or parts thereof, will probably not be tested under operating conditions.

Scientific investigations may have limits of acceptability, but these limits will be applied to data and not to items. For example, data should only be accepted if operators use equipment that is operated and calibrated properly. Typically, operators recognize that equipment is not operating properly or is not calibrated properly when measured values fall outside a particular range. For example, in well logging, the operator of the resistivity tool may suspect that the tool is not calibrated properly if the value for the resistivity of a particular formation is not in the range of values measured for that formation in nearby locations or for values measured for a similar formation. Another example of acceptance criteria in logging is the hole size for the collection of certain types of logging data. If the hole is washed out over a certain interval in the well bore, density data collected for this interval are suspect. Thus, one acceptance criteria for density data should limit the corresponding hole size for which the data are collected.

In summary, the wording in the reactor requirement quoted above does not reflect the nature of scientific investigations and, therefore, cannot be applied. In reviewing the remaining seventeen (17) requirements in Appendix B, the staff determined that they also do not completely address the needs for control of scientific investigations. Therefore, the requirements in Appendix B must be supplemented. The staff will look to the basic messages contained in 10 CFR Part 50 Appendix B, NQA-1, and the guidance found in NQA-3 to draft the supplemental guidance. For example, the basic message of the requirement quoted above is that tests should be identified and performed in accordance with procedures. This message equally applies to scientific investigations and the revision to Appendix A of the HLW QA Review Plan reflects this message.

B. Data

Appendix B and NQA-1 do not provide adequate guidance for data as input to performance assessment, existing data, reviews of data collection and analysis, and coordination between design staff and data collection

staff. In the repository program data will be collected, analysed, purchased, and used as input to design and performance assessment. The existing guidance in NQA-1, the requirements in Appendix B, and the new guidance in NQA-3, however, can be used as the basis for establishing supplemental guidance in these areas.

1. Data as Input

The design control criterion in Appendix B and the corresponding NQA-1 guidance covers design input. The repository program will have data as input to engineered design as well as for input to the performance assessment. The revision, like the 1984 version of Appendix A, will contain QA measures for input to performance assessment that are similar to the existing requirements for design input.

2. Existing Data

In the repository program, DOE will use some data that was collected outside of the repository program. This existing data probably was collected without the benefit of a formal quality assurance program and the requirements in 10 CFR Part 50 Appendix B do not address the use of such data. Accordingly, the NRC has issued a generic technical position which addresses this data and offers methods to qualify it. Some of this data may be qualified by confirmatory testing, comparison with corroborating data, and/or comparing the quality assurance program under which it was collected with existing QA requirements. Even these methods will not qualify some data which cannot be reproduced. The generic technical position on existing data provides the method of peer review to qualify this data. Accordingly, the revision references the Generic Technical Position on Qualification of Existing Data for High-Level Nuclear Waste Repositories and the Generic Technical Position on Peer Review for High-Level Nuclear Waste Repositories.

3. Reviews of Data Collection Plans and Data Analyses

The reactor requirements in 10 CFR Part 50 Appendix B do not address reviews of data collection plans or the results of data analyses. Quality assurance measures should include reviews that will challenge assumptions, methods, and interpretations identified in plans and used in data analyses. The draft revision references the generic technical position on peer review for reviews of data collection plans and results of data analysis.

4. Coordination of Design and Data Collection

The successful completion of the repository design is dependent on (1) the data and data quality that will result from data collection and analysis activities, (2) the adequacy of the design, and (3) the interaction between engineered design items and the natural systems. The

revision will contain guidance to coordinate between the design effort and the data collection efforts. This guidance will be based on the requirements in 10 CFR Part 50 Appendix B for design control.

SUMMARY

The differences between reactor QA and repository QA include the timing of the programs, the differences in terminology, and the special needs for site characterization. The revision to the 1984 Quality Assurance Review Plan for Site Characterization will incorporate lessons learned, will replace reactor specific terminology and will contain supplemental guidance for site characterization. The supplemental guidance will be based on existing requirements in 10 CFR Part 50 Appendix B and guidance found in NQA-3. The revision also will provide supplemental guidance by referencing the three generic technical positions, qualification of existing data, peer review, and Q-List.