DEVELOPING A LICENSE APPLICATION FOR A FIRST-OF-A-KIND FACILITY USING A ONE-OF-A-KIND REGULATION AND REVIEW PLAN

M. C. Bryan
Beckman and Associates
9980 Covington Cross Dr., Las Vegas, NV 89144

ABSTRACT

This paper discusses the precedents that were available, and those that were not, for building a high-level radioactive waste repository. To obtain a license to receive and possess spent nuclear fuel and high-level radioactive waste from the U.S. Nuclear Regulatory Commission, the U.S. Department of Energy must submit a license application that includes both a general information portion and a safety analysis report. The regulation that governs these activities, 10 CFR Part 63, only applies to Yucca Mountain and was developed as a risk-informed, performance-based rule. The closest analogies for the surface facility portion of the repository are storage facilities for nuclear material that are licensed in accordance with 10 CFR Part 72, which consists of a one-step licensing process that requires a different level of information than that necessary for the Yucca Mountain license application.

This paper will describe the process of determining the appropriate type and level of information necessary to include in the license application to ensure that it is docketable and that it supports the U.S. Nuclear Regulatory Commission needs. The research to this end has involved reviewing the existing safety analysis reports and U.S. Nuclear Regulatory Commission review plans to define the optimum way to arrange and present the information in the license application. This paper will also discuss the approach to developing and reviewing a large document that affects a large number of internal and external organizations, each with a vested interest in the success of the license application.

INTRODUCTION

In order to obtain a license to receive and possess spent nuclear fuel and high-level radioactive waste, the U.S. Department of Energy (DOE) must submit a license application (LA) to the U.S. Nuclear Regulatory Commission (NRC) that includes a general information portion and a safety analysis report (SAR) that conform to a risk-informed, performance-based framework. The two documents that the NRC will use to review the LA are 10 CFR Part 63 [1] and the Yucca Mountain Review Plan, Final Report (YMRP) [2], which the NRC developed as guidance to review the application. This LA must serve two licensing actions: the first, a license granting construction authorization, the second an update of the LA to obtain a license to receive and possess spent nuclear fuel and high-level radioactive waste. There are numerous precedents involving SARs for commercial nuclear facilities and nuclear fuel production facilities, but there are no licensed geologic repositories, and most nuclear facilities were not licensed to a risk-informed regulation.

BACKGROUND

Prior to issuance of the YMRP [2], industry precedent from reactor and fuel storage facilities was primarily used to define what would be required in an LA. One of the biggest challenges in defining the format for the LA was to adapt a situation with two licensing actions–a construction authorization and a license to receive and possess spent nuclear fuel and high-level radioactive waste–and apply it to a review plan that did not always delineate what was required for each stage. There are two documents for commercial nuclear reactors to follow when applying for a license: NUREG-0800, Standard Review Plan for the Review of Safety Analysis Reports for Nuclear Power Plants [3], and Regulatory Guide 1.70,

Standard Format and Content of Safety Analysis Reports for Nuclear Power Plants [4]. NUREG-0800 [3] provided the review criteria the NRC used in evaluating a SAR, and Regulatory Guide 1.70 [4] provided instructions on how the document should be arranged, along with some additional clarification on what should be included. For Yucca Mountain, only the YMRP [2] exists, and it functions more as a review plan than a format and content guide. The NRC has expressed a preference that the LA follow the format of the YMRP [2], but the review plan itself does allow that a cross-reference between the YMRP [2] and the application can be provided if the YMRP format is not followed. In general, the LA follows the format of the YMRP [2], but there were some changes made for presentation purposes.

For commercial reactors, NUREG-0800 [3] often specifically identified what was needed at the construction permit stage, as well as the additional information needed for the operating license stage. The programmatic areas of the YMRP [2] do provide some distinction for the various stages, but the design areas generally do not. However, 10 CFR 63.21(a) [1] acknowledges that not all information has to be available at the time of the initial LA: "The application must be as complete as possible in the light of information that is reasonably available at the time of docketing." In general, the philosophy of the DOE is to provide sufficient information to allow the NRC to make the findings required by 10 CFR 63.31 [1]. This regulation includes statements about making a finding of reasonable assurance that the types and amounts of radioactive materials described in the application can be received and possessed without unreasonable risk to the health and safety of the public. It also states that there is reasonable expectation that the materials can be disposed of without unreasonable risk to the health and safety of the public.

The format provided in the YMRP [2] contains one chapter for general information and one chapter for the SAR. The general information portion contains:

- A general description of the repository
- Schedules for construction, receipt, and emplacement of waste
- A description of the physical protection plan
- A description of the material control and accounting plan
- A description of the site characterization work.

This format is matched in the Yucca Mountain Project (YMP) LA.

The SAR portion of the YMRP [2] contains a preclosure safety analysis section. This section includes the following:

- A description of the site and its features that could have an impact on the preclosure safety analysis
- A description of structures, systems, and components (SSCs), as well as operational process activities
- Several sections that represent the analysis of the preclosure material, including identification of hazards and initiating events, identification of event sequences, consequence analyses, and identification of SSCs important to safety

- Design of SSCs
- A discussion of the requirements for keeping doses as low as is reasonably achievable
- Plans for retrieval and alternate storage of waste
- Plans for permanent closure.

The YMP took the approach that for presentation and SAR maintenance purposes, it was better to provide the SSC description, operation, and design together, rather than segmenting them as presented in the YMRP [2].

- The postclosure portions of the YMRP [2] include:
- A system description and identification of multiple barriers
- Scenario analysis and event probability
- Model abstraction
- Demonstration of compliance with postclosure standards.

The YMP SAR follows this format, with the exception that the sections in the model abstraction area have been replaced with the YMP conceptualization of the repository system.

The YMRP [2] contains a section on the research and development program to resolve safety questions. This section addresses any further technical information that may be required to resolve issues regarding adequacy of design and adequacy of the natural and engineered barriers. If the YMP determines that any such items meet these criteria, those items will be included in a separate chapter of the LA.

The YMRP [2] also has a section that provides the expectations for a performance confirmation program. Performance confirmation is a program of tests, experiments, and analyses that is conducted to confirm the performance of the repository system as analyzed and to demonstrate readiness to proceed to closure. Performance confirmation will also be included in a separate chapter of the LA.

The final section of the YMRP [2] addresses administrative and programmatic requirements that are to be addressed in the LA. This section includes the following:

- The quality assurance program description
- A description of records, reports, tests, and inspections
- A description of the training and certification of personnel, including the proposed organizational structure
- A description of how expert elicitation is used
- A description of plans for start-up activities and testing
- A description of plans for the conduct of normal activities

- A description of the emergency plan
- A description of the controls to restrict access and regulate land uses
- A description of any uses of the repository for purposes other than disposal
- A description of probable license specifications.

The YMP SAR follows the format used in the YMRP [2] for this section.

PROCESS

To determine the appropriate content for the LA, the following three major areas were evaluated independently:

- Programmatic–Including the general information, administrative, and programmatic areas of the SAR
- Preclosure–Including the site description, design information, and preclosure safety analysis
- Postclosure–Including discussions of multiple barriers; features, events, and processes; model abstraction; and the results of the total system performance assessment.

The programmatic sections largely focus on the plans and programs required for a repository. In commercial reactors, most of these plans and programs were developed and provided to the NRC during the operating licensing phase, as opposed to the construction permit phase. In stand-alone fuel storage facilities, these plans were provided with the application because stand-alone fuel storage facilities essentially follow a one-step licensing process, as described in 10 CFR 72 [5]. In general, the LA will describe the contents of the various plans and programs, with the plans and programs themselves to be submitted later, as appropriate.

The design sections focus on providing a description of:

- The SSCs, including their functions
- The design basis for those SSCs credited with performing a safety function
- The design criteria to which those SSCs will be built
- The methodology used for analysis
- A summary of the results.

Reactor and fuel storage facility SARs provide acceptable models on the appropriate level of information to be included. The repository differs, however, because an accident without a high-energy initiation is significantly different. The safety strategy for the repository, therefore, is to provide prevention and passive mitigation.

During early interactions between the NRC and the DOE, there was much discussion about the level of detail to be included in the LA, particularly regarding the design aspects of the facility. There was a concern that the design-related information would not have sufficiently matured to provide the needed data for the LA because much of the DOE focus had been on site characterization and postclosure performance.

To reach a common understanding of an acceptable level of design detail in the LA, the DOE recently provided sample SAR sections to the NRC. The section on the dry transfer facility heating, ventilation, and air-conditioning system was chosen because it was related to similar systems in other facilities the NRC had reviewed; it was assumed, therefore, that it would provide common ground for discussions. The information in this sample was largely based on the amount and type of information presented in a commercial nuclear SAR for a heating, ventilation, and air-conditioning system for a fuel handling building.

The NRC also wanted the DOE to submit a sample section of a nonstandard system that was not based on available codes and standards. The ground support system was chosen because ground support is not a type of structure traditionally found in the nuclear industry; nor, therefore, are there any nuclear industry codes or standards upon which to base the design. Additionally, even standards used in the mining industry could not always be applied because of the need to avoid using cement as a material in the emplacement drifts for postclosure performance reasons.

Because these samples need to be discussed well before the actual system design is completed, the DOE has emphasized that the samples do not necessarily reflect the actual system that will be designed and constructed. The sample sections were not provided for a technical review; they were to be used solely to facilitate a discussion about how much detail to present in the LA. The lesson learned from producing samples for these systems is that SAR preparation is an art that involves giving for the reviewer enough information to understand system operation and design, while avoiding unnecessary detail and descriptive material that could be misconstrued as licensing commitments, particularly where systems that are not important to safety are concerned. Many people working on the YMP LA were also involved with commercial nuclear utilities that had to review their updated final SARs to ensure that the information presented was still valid. These individuals are sensitive to the fact that whatever goes into the SAR must be maintained up to date. Therefore, gratuitous commitments and extraneous detail must be excluded to prevent future maintenance problems.

The postclosure sections are largely unique to the repository because the regulatory compliance period is 10,000 years, rather than a typical nuclear facility life of 40 to 60 years. In addition, compliance with the regulatory limits for the repository is evaluated on a probabilistic basis, rather than a deterministic basis. For these reasons, a thorough discussion of the data and models, as well as a discussion of their uncertainty, is needed.

Particular challenges facing postclosure information include describing how the various barriers ensure that performance objectives are met, as well as providing the reader with an understanding of how the repository system works and how the individual processes are modeled. During the process of prelicensing interactions with the NRC, it became apparent that an explanation about how these processes worked was needed, rather than just a compliance demonstration. To fill that need, technical basis documents were written to describe the processes and methods of modeling. These technical basis documents proved to be valuable informational tools. Subsequently, the decision was made to use these technical basis documents to form a large part of the postclosure section of the LA. Each technical basis document had to be adapted to the format of the LA, and discussions addressing requirements of 10 CFR Part 63 [1] and the YMRP [2] had to be integrated. As a result, the LA increased in size, but the objective of providing a greater level of understanding about the processes and models used was met.

In addition to the three categories discussed above, the LA must address the performance confirmation program and the program to resolve safety questions, if any are identified. The performance confirmation program, which has both preclosure and postclosure requirements, is unique to the repository. Criteria for the parameters monitored are being established to compare the repository performance with the assumed performance. The program to resolve safety questions does have a corollary to commercial nuclear facilities as defined in 10 CFR 50.34(a)(8) [6]. However, typically this section for commercial nuclear reactors involved programs under development by the reactor vendors and, while providing insights on how to present the information, is largely not directly applicable. As the technical work to support the LA is being completed, the YMP will determine if there are any safety questions remaining that should be included in this section. If there are, the research and development program to resolve safety questions will be identified to show how the information will be obtained, as well as to provide a schedule for resolving the safety questions.

One final unique aspect of the repository is the diversity of entities involved. Besides the DOE and Bechtel SAIC Company, LLC, various other entities have a role in developing and reviewing the LA. These entities include national laboratories, subcontractors, the National Nuclear Spent Fuel Program, Naval Reactors, and other organizations. Recognizing that a timely review by the parties was key to completing the LA on time, the LA is being developed on a section-by-section basis. This approach allows a preliminary licensing review to ensure the draft material is adequately presented from a regulatory perspective, as well as a technical team review by the affected parties to ensure each draft receives a multidisciplinary review. In the summer of 2004, the LA will begin a joint BSC and DOE management review to help ensure consistency of presentation across the document. This review will combine several of the individual sections of the LA that have previously undergone technical team review. In the fall of 2004, this document will be provided to DOE for their final approval.

The review process is being evaluated for effectiveness. Performance indicators, which are reviewed by senior management on a monthly basis, have been developed to monitor the progress and quality of the LA development process. These indicators include:

- Monitoring current LA development progress versus schedule
- A review of the forecast of the LA sections to determine if they are being projected late so that corrective actions may be taken early
- Monitoring of the quality of the LA sections so that the appropriate feedback can be provided to the originating organizations.

CONCLUSION

In summary, there are many unique aspects to the repository and the regulations that govern it, and the DOE has tried to take advantage of as much precedent as is relevant. Sound science and solid engineering that meet the regulatory performance requirements are essential, but the key to a successful LA depends on continuing communications with the NRC to ensure that the approaches taken to meet this facility-specific licensing process are well understood and meet NRC requirements and expectations.

REFERENCE

1 10 CFR 63. Energy: Disposal of High-Level Radioactive Wastes in a Geologic Repository at Yucca Mountain, Nevada.

2 NRC (U.S. Nuclear Regulatory Commission) 2003. Yucca Mountain Review Plan, Final Report. NUREG-1804, Rev. 2. Washington, D.C.: U.S. Nuclear Regulatory Commission, Office of Nuclear Material Safety and Safeguards.

3 NRC (U.S. Nuclear Regulatory Commission) 1987. Standard Review Plan for the Review of Safety Analysis Reports for Nuclear Power Plants. NUREG-0800. LWR Edition. Washington, D.C.: U.S. Nuclear Regulatory Commission.

4 Regulatory Guide 1.70, Rev. 3. 1978. Standard Format and Content of Safety Analysis Reports for Nuclear Power Plants LWR Edition. Washington, D.C.: U.S. Nuclear Regulatory Commission.

5 CFR 72. Energy: Licensing Requirements for the Independent Storage of Spent Nuclear Fuel, High-Level Radioactive Waste, and Reactor-Related Greater than Class C Waste.

6 CFR 50. Energy: Domestic Licensing of Production and Utilization Facilities.