Regulatory Review of Early Site Permit Applications

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Abstract – *The U.S. Nuclear Regulatory Commission (NRC) has received and is reviewing three applications for early site permits (ESPs). The ESP process allows early resolution of site-related issues affecting possible construction and operation of a new nuclear power plant. The nuclear industry views a successful and predictable ESP process as an important step in assessing whether to seek authorization to construct and operate a new generation of nuclear power reactors in the United States. Because consideration of ESP applications is a first-of-a-kind activity, a number of issues have emerged prior to and during the reviews of the first three applications. Issues have included the need for design information at the ESP stage, accident analyses, quality assurance, and seismic analyses. The NRC has been working to resolve identified issues to support a Commission decision on whether to issue an ESP approximately 33-37 months after receipt of each ESP application.*

I. INTRODUCTION

On September 25, 2003, representatives of two firms potentially interested in constructing one or more new nuclear power plants delivered applications for early site permits (ESPs) to the U.S. Nuclear Regulatory Commission (NRC). Exelon Generating Company, LLC submitted an application for a site adjacent to the Clinton Power Station near Clinton, Illinois,[1] and Dominion Nuclear North Anna, LLC submitted an application for a site adjacent to the North Anna Power Station near Mineral, Virginia.[2] Subsequently, on October 21, 2003, System Energy Resources, Inc. (a subsidiary of Entergy Corporation) submitted an application for a site adjacent to the Grand Gulf Nuclear Station near Port Gibson, Mississippi.[3] These were the first new applications related to licensing a reactor for construction and operation submitted to the NRC since the 1970s. Of course, an ESP does not in and of itself authorize significant construction at the site. But obtaining an ESP is a possible first step toward eventual deployment of a new nuclear power plant.

The NRC has accepted the ESP applications for docketing, and the NRC staff has begun its technical review of the applications. As first-of-a-kind licensing activities, these reviews and the NRC's preparation for them have resulted in identification of a number of issues. The NRC staff has implemented guidance documents and an issue resolution process for the ESP reviews to support the Commission's goals of protecting public health and safety and the environment, ensuring openness in the regulatory process, and ensuring that NRC actions are effective, efficient, realistic, and timely.

II. BACKGROUND

All the approximately 100 currently operating commercial nuclear power plants in the United States are licensed under the NRC's regulations in 10 CFR Part 50, "Domestic Licensing of Production and Utilization Facilities." Licensing actions under 10 CFR Part 50 include construction permits and operating licenses. In the past, design of many plants was largely incomplete when construction began, so design and construction advanced more or less in parallel, a process that often led to rework, delays, and additional expenses. Also, the Part 50 process requires an applicant for a new nuclear power plant to substantially complete construction of the plant before receiving an operating license. Therefore, technical issues such as those related to the site or the plant design might remain open even as plant construction continues. It would be possible that resolution of open issues, or issues identified during construction, might

require changes to the plant design after construction of the affected structures, systems, and components has begun or even been completed. In the worst case, there could be an irresolvable site or design issue that might prevent successful attainment of an operating license. Given the cost of and time involved in construction of a nuclear power plant, the licensing uncertainties associated with this process have been viewed as a major disincentive for construction of new nuclear power plants.

In 1989, in an effort to provide a more stable, predictable licensing process and to enhance safety by providing a process for certifying standard nuclear power plant designs, the NRC issued 10 CFR Part 52, "Early Site Permits; Standard Design Certifications; and Combined Licenses for Nuclear Power Plants." Part 52 includes separate subparts that address early site permits (Subpart A), design certifications (Subpart B), and combined licenses (COLs) (Subpart C). Figure 1 depicts the relationship among these various activities. It is important to recognize that an entity considering constructing and operating a new nuclear power plant has a number of options. The process that most comprehensively invokes Part 52 is for the holder of an ESP to reference the ESP and a certified reactor design in a COL application. Using the ESP process, site-related issues may be resolved prior to the applicant needing to make substantial investment in design of a reactor. As will be discussed in more detail later in this paper, the ESP applicant does not need to identify a specific design in the ESP.

Once site issues are resolved at the ESP stage, in accordance with NRC's regulations, such resolved issues remain resolved and not subject to litigation at the COL stage, unless a contention is admitted that the site is not in compliance with the terms of the ESP, that a reactor to be sited does not fit within the site parameters specified in the ESP, or that the terms and conditions of the ESP should be modified. In this way, the scope of issues that must be addressed at the COL stage is reduced. If the COL application also references a certified design, the number of potential issues to be addressed at COL drops even further. In any event, remaining issues are resolved at the COL stage, so the holder of a COL, now ready to begin plant construction, can have a high confidence that regulatory issues will not adversely impact successful, timely plant construction. The COL holder will, however, ultimately need to demonstrate that the plant has been constructed in accordance with the terms of the license.

The applicant may choose to invoke some but not all subparts of Part 52. For example, it may choose to submit a COL application without referencing an ESP, without referencing a certified design, or without referencing either. Obviously, such a choice would mean that more

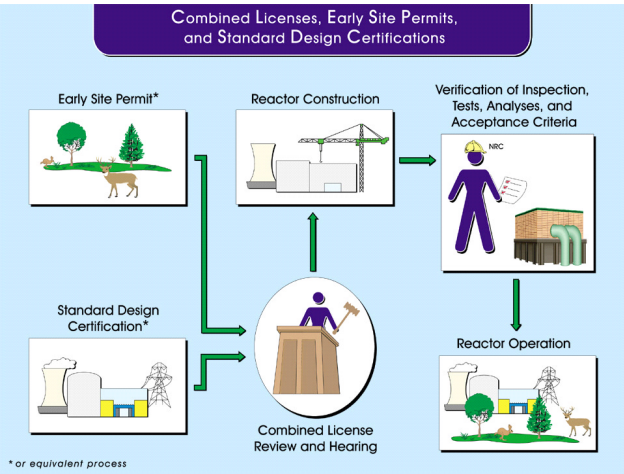

Fig. 1. 10 CFR Part 52 licensing process

issues would remain subject to resolution and litigation at the COL stage, resulting in additional regulatory uncertainty and likely a longer regulatory review period. Still another option would be to reference an ESP or certified design in an application for a construction permit under Part 50. An applicant could even submit an application entirely under Part 50. However, the lack of applications for construction permits over the last 25 years, during which time Part 50 has been in effect, suggests this option is unlikely to be exercised.

III. ESP REVIEW GUIDANCE

In accordance with 10 CFR Part 52, the ESP application must contain a site safety assessment, an environmental report, and emergency planning information. The NRC has developed a staff guidance document to delineate specific technical areas to be reviewed by the NRC staff. The staff developed this document, Review Standard (RS)-002, "Processing Applications for Early Site Permits,"[4] using existing NRC standard review plans as starting points. For review of the site safety assessment, the reference document was NUREG-0800, "Standard Review Plans for the Review of Safety Analysis Reports for Nuclear Power Plants"[5]; for the environmental review, the reference document was NUREG-1555, "Environmental Standard Review Plan."[6] These documents were reviewed, section by section, for applicability to an ESP application review in accordance with Part 52 and with 10 CFR Part 100, "Reactor Site Criteria," which is referenced for ESPs by 10 CFR Part 52. For NUREG-0800 sections deemed applicable, the staff developed corresponding RS-002 sections by eliminating guidance within the sections not appropriate for ESP reviews and by reflecting the Part 52 licensing process, which was not in existence when most of

NUREG-0800 was last updated. General NUREG-0800 subject areas deemed applicable to the ESP review were hydrology, seismology, meteorology, geology, offsite and onsite hazards, emergency planning, accident analysis, and quality assurance. Table I shows a complete list of applicable subject areas.

Unlike NUREG-0800, NUREG-1555 reflects the ESP review process. Because it was updated much more recently than NUREG-0800, the staff merely referred to it in RS-002 with a few clarifications, rather than developing new review guidance sections as was done for site safety assessment sections. In addition, almost all subjects in NUREG-1555 are applicable to an ESP, because the regulations require the impacts of a plant that might be built on the site to be evaluated. In contrast, much of NUREG-0800 relates to design information, which is generally inapplicable to the ESP review.

The NRC staff released the draft RS-002 for public comment in two parts, in December 2002 and April 2003. Comments were received from the Nuclear Energy Institute (NEI), two prospective ESP applicants, and two advocacy organizations. The staff addressed the comments received and, with Commission approval, issued the "Final" RS-002 in spring 2004.

IV. ESP ISSUES

As would be expected in a first-of-a-kind process, a number of issues have emerged before and during reviews of the three initial ESP applications. Prior to submittal of the first three ESP applications, the NRC met with NEI and the prospective ESP applicants in several public meetings to discuss and attempt to resolve as many issues as possible before application submittal. The result of these interactions was a series of letters documenting NEI's proposed resolutions and NRC's positions on these issues. Examples of the issues and their resolution are discussed briefly below. The NRC and NEI letters may be viewed on the NRC's public website at http://www.nrc.gov/reactors/new-licensing/license-reviews/esp/generic-esp-issues.html.

With the ESP applications now under review, issue resolution emphasis has shifted to addressing issues identified with the individual applications. These issues are being addressed using the NRC's established process of developing and documenting requests for additional information (RAIs), sending them to the applicant, and receiving and reviewing applicant responses to the RAIs. Issues that remain open when the staff's draft safety evaluation report (SER) is issued are identified as such in the SER. The applicant's goal is to resolve these open items before issuance of the final SER, whose conclusions are a major part of the Commission's ultimate decision on whether or not to issue an ESP.

TABLE I

Applicable subject areas for review of ESP site safety assessments

Site location and description
Exclusion area authority and control
Population distribution
Potential hazards in site vicinity
Evaluation of potential accidents
Regional climatology
Local meteorology
Onsite meteorological measurement programs
Short-term atmospheric dispersion
Long-term diffusion
Aircraft hazards
Radiological consequence evaluations
Hydrologic description
Floods
Probable maximum flood on streams and rivers
Potential dam failures
Probable maximum surge and seiche flooding
Probable maximum tsunami flooding
Ice effects
Channel diversions
Cooling water supply
Groundwater
Accidental releases of liquid effluents
Basic geologic and seismic information
Vibratory ground motion
Surface faulting
Stability of subsurface materials and foundations
Stability of slopes
Emergency planning
Physical security
Quality assurance

IV.A Plant Parameter Envelope

Part 52 was written under the assumption that an ESP applicant would likely submit an application that would reference the type, number, and thermal power of reactors to be sited. Certain characteristics of the design submitted would be used to support the dose consequence (accident) analyses required by Part 52. However, it is likely that proposed reactor designs will continue to evolve over the term of an ESP (up to 20 years). Therefore, ESP holders would prefer to maintain flexibility about what design they might eventually wish to site, so they would prefer not to submit a single design at the ESP stage. The regulations do not require selection of a single design, and the NRC has determined that an ESP applicant can submit

a set of bounding plant parameters, referred to as a plant parameter envelope (PPE), in lieu of specifying reactor type, number, and thermal power. PPE values can also be used as inputs to dose consequence analyses, as will be discussed in more detail later in this paper.

PPE values are likely to be composites not necessarily indicative of any specific reactor design or type. The NRC staff's review of PPEs submitted by ESP applicants will determine (1) whether the PPE values are sufficient to enable the NRC staff to conduct its required review, and (2) that the PPE values are not unreasonable for consideration in the staff findings to comply with Subpart A of 10 CFR Part 52.

A COL applicant referencing a PPE would need to demonstrate that the design chosen for the COL falls within the PPE specified at ESP. Design characteristics falling outside the PPE would be subject to re-analysis and litigation at COL to demonstrate that the design is compatible with the site.[7]

All three ESP applications received to date reference a PPE rather than providing information for a specific design. Each applicant selected a PPE whose values reflect their considerations regarding potential reactor types that might be sited and other site-specific considerations. For example, the values for condenser/heat exchanger duty would likely differ among applicants considering different reactor designs or different thermal power levels. The NRC staff is reviewing the PPEs to verify that they are sufficient to enable the NRC to conduct its required review and to verify that the PPE values are not unreasonable for consideration in the staff's findings regarding compliance with Parts 52 and 100.

IV.B Quality Assurance

Subpart A of Part 52 does not explicitly address quality assurance or invoke the quality assurance measures of Appendix B to 10 CFR Part 50, and ESP applicants need not submit quality assurance plans or program descriptions with their applications. However, as previously noted, the NRC's findings at the ESP stage are final, absent certain limited circumstances. Therefore, the NRC needs to have reasonable assurance at the ESP stage in the integrity and reliability of site-related information that could adversely impact the performance of future plant systems, structures, and components important to safety. The NRC has therefore taken the position that such site-related information should be subjected to quality assurance measures equivalent in substance to those specified in Appendix B to Part 50. The NRC has informed NEI and the three ESP applicants that any findings of inadequacy regarding an ESP applicant's QA measures would be based on the applicant's inability to demonstrate integrity and reliability of the data that support the safety case in the application, not on deviations from Appendix B to Part 50.[8] The NRC is reviewing the three ESP applications and (where necessary) has sought additional information from the ESP applicants to allow the NRC staff to make these determinations.

IV.C Environmental Issues

As previously noted, an environmental report is required at the ESP stage, and the staff will review the environmental report and write an EIS in accordance with the National Environmental Policy Act of 1969 (NEPA), as amended. The NRC's regulations and Commission decisions allow ESP applicants to exclude certain considerations, such as the need for and cost of power, as well as alternative energy sources. Such considerations are not considered necessary to the determination of whether a proposed site is suitable to host a nuclear power plant or plants, but rather pertain to consideration of whether to actually construct a nuclear plant. Therefore, these subjects must be addressed at the COL stage if not addressed at the ESP stage.

Alternative sites are considered from the standpoint of identifying any obviously superior alternative sites to the one chosen by the ESP applicant. This consideration has evolved because the industry has also evolved. A potential owner of a new reactor may be a merchant vendor with no defined service area, so a reasonable boundary when considering alternative sites is not as easily identified as was the case when electric generating companies were confined to a particular area.

NEI proposed that consideration of alternative sites be limited to sites with existing nuclear facilities if the applicant proposes a site for an ESP that is collocated with an existing reactor. The NRC staff informed NEI[9] and the ESP applicants that consideration of alternative sites may be limited with regard to the proposal being made, but that the applicant must provide reasonable bases for proposed limitations.

In another issue related to environmental reviews for an ESP, NEI proposed (and the staff accepted) that the License Renewal Generic Environmental Impact Statement (GEIS) be considered acceptable to support the environmental report for an ESP application, subject to the need to demonstrate the relevance of the referenced material.[10]

Consideration of the impacts of severe accidents, as well as consideration of alternatives to mitigate such potential impacts, is an important aspect of NEPA. The

NRC has determined that consideration of severe accidents is needed at the ESP stage. If design information is not available to support this consideration, the ESP applicant may evaluate the impacts using its PPE. A future COL applicant referencing the ESP would need to demonstrate that the impacts evaluated at the ESP stage are bounding. The staff agreed that consideration of severe accident mitigation alternatives is not practical in the absence of specific design information, and therefore that consideration of such alternatives could be deferred to the COL stage.[11]

IV.D Emergency Planning

An ESP applicant has several options for meeting regulatory requirements regarding emergency planning at the ESP stage. The applicant must evaluate site features for any that could pose a significant impediment to development of emergency plans. In addition, it may choose to either describe major features of its emergency plan or to provide the complete and integrated emergency plans.

The staff has determined that emergency planning information for an ESP need not be kept updated by the ESP holder, but the staff is also proposing in a new rulemaking that the information must be updated at the time a COL application references the ESP and that the COL applicant must discuss whether the new information materially changes the bases for compliance with NRC requirements.[12]

Because all three ESP applications are for sites that already host nuclear power plants and therefore have emergency plans in place, the emphasis at the ESP stage is on identifying impacts that the presence of additional plants would have on emergency planning for the site. The staff has stated in a letter to NEI[12] that ESP applicants should have documented arrangements and understandings with offsite emergency management agencies that reflect understanding and agreement on the potential impacts of the new plants.

IV.E. Seismic Issues

The regulations in 10 CFR 100.23 require an ESP applicant to investigate the geological, seismological, and engineering characteristics of the proposed site to support estimates of Safe Shutdown Earthquake ground motion and to permit engineering solutions to actual or potential geologic and seismic effects at the site. In addition, the applicant must determine the potential for surface tectonic and nontectonic deformations, design bases for seismically induced floods and water waves, and other design conditions as stated in the regulations. Uncertainties in the Safe Shutdown Earthquake estimates must be addressed through an appropriate analysis, such as a probabilistic seismic hazards analysis or suitable sensitivity analyses.

Before the three ESP applications were submitted, the NRC staff, after interacting with stakeholders, developed several positions related to meeting these regulations. For example, the staff addressed the question of what constitutes acceptable subsurface investigations in view of the fact that large-scale excavations will not be conducted before issuance of an ESP. The staff stated to NEI and the ESP applicants that coverage of subsurface investigations should be sufficient to provide reasonable assurance that actual site characteristics revealed during construction-related excavations will be consistent with the site subsurface model developed to support the ESP application. Further, the ESP may contain a license condition requiring the reporting of information identified as having a significant implication for public health and safety. An example of such information might be conditions identified during excavation that call into question the validity of the site subsurface model developed and accepted at the ESP stage.[13]

As events developed, completion of seismic analyses caused delays of several months in submittal of two of the three ESP applications. All three applicants had decided to use a new ground motion attenuation study developed by the Electric Power Research Institute (EPRI)[14] to support their evaluations of uncertainties in Safe Shutdown Earthquake estimates. The final version of this study was available to the applicants later than they had expected and after their originally planned ESP application submittal dates. The NRC had not received or reviewed the EPRI report prior to receipt of the three ESP applications.

IV.F. Accident Analyses

The regulations in 10 CFR 52.17 require that an ESP applicant's safety assessment include an "analysis and evaluation of the major structures, systems, and components of the facility that bear significantly on the acceptability of the site under the radiological consequence evaluation factors identified in 10 CFR 50.34(a)(1)." Compliance with this regulation requires calculating doses from postulated design basis accidents for hypothetical individuals located at any point on the exclusion area boundary for a two-hour period and for hypothetical individuals located on the outer boundary of the low population zone for the course of the accident. These doses are then compared with limits specified in the regulations.

NEI had taken the position that the parameter of interest at the ESP stage is the relative concentration (X/Q) and that the determination that the radiological dose criteria are met can only be made at the COL stage "when both the site and design are known and interface issues can be evaluated."[15] However, the NRC staff noted in a letter to NEI that an ESP is an independent licensing action, that the applicable regulations in Parts 52 and 100 must be met at the ESP stage, and that the NRC must evaluate whether a reactor or reactors having characteristics that fall within the parameters of the site can be constructed and operated without undue risk to the health and safety of the public. Use of X/Q alone does not demonstrate compliance with the regulations or show no undue risk. Therefore, the staff informed NEI that a dose assessment is necessary at the ESP stage. The staff also stated that an ESP applicant may use a PPE to define the design parameters for use in the dose calculation. The ESP applicants have taken the approach of using release parameters for recent advanced reactor designs in the dose assessments. Should ESPs be issued for one or more of these sites, a COL applicant seeking to reference the ESP would need to demonstrate that the designs and accidents analyzed at the ESP stage bound those for the actual reactor design chosen at the COL stage. Should this not be the case, the accident analyses become issues to be addressed at the COL stage.[16]

V. APPLICATION REVIEWS

As previously noted, the NRC staff is reviewing all three ESP applications. The staff initially reviewed the three applications for completeness and found all three sufficiently complete to docket the applications and begin the technical reviews that will ultimately help determine whether an ESP will be issued in each case. The technical reviews address site safety and emergency planning (as documented in the NRC staff's safety evaluation report) and environmental impacts (as documented in the staff's environmental impact statement). The staff's technical review is nominally scheduled to be complete (i.e., safety evaluation report and environmental impact statement issued) 21 months after receipt of each application. The completion date for the Dominion application review is therefore June 2005. However, to deal with the fact that all three applications were received within a three-week period, to integrate staff resources with reviews of license renewal applications, and to respond to budget limitations, completion of the staff's review products for the Exelon and Entergy applications will follow completion of the Dominion products by two and four months, respectively.

In addition to the development of the safety evaluation report and the environmental impact statement, the review process for each ESP application includes a mandatory hearing. The purpose of the hearing is to determine whether a reactor or reactors falling within the parameters for the site can be constructed and operated without undue risk to the health and safety of the public. The presiding authority for the hearing also must determine whether, in accordance with the regulations of 10 CFR Part 51, "Environmental Protection Regulations for Domestic Licensing and Related Regulatory Functions," an ESP should be issued as proposed. The hearing may be presided over by one or more members of the Commission, an atomic safety and licensing board, or a named officer delegated final authority on the matter. The hearing will occur after completion of the staff's review products.

In addition, the Advisory Committee on Reactor Safeguards (ACRS) will review each application and the staff's safety evaluation report and will report to the Commission on those portions of the application that concern safety.

After the hearing is conducted and the ACRS report is received, the Commission will decide whether or not to issue the ESP in each case. The estimated decision date for the Dominion ESP application is June 2006, Exelon in August 2006, and Entergy in October 2006. However, because the staff does not control the hearing process, these time frames are rough estimates.

Given these estimated ESP decision dates, it is worthwhile noting that there has been considerable discussion recently regarding prospects for and timing of COL applications, especially given the DOE's recent cost-sharing solicitation for COLs.[17] As was previously noted, the simplest case at COL is for the applicant to reference a certified design and an ESP. However, a possible variant on that scenario is submittal of a COL application that references an ESP application and/or a design certification application currently under NRC review. The reviews then proceed more or less in parallel. Such an approach, while bringing somewhat more uncertainty than does referencing an ESP and approved design certification, is allowable under the regulations and could be the way initial COL applications are pursued.

Note: Additional information related to ESPs, including the three ESP applications and public comments on NRC's regulatory guidance for ESP reviews, can be found on the NRC's public web site at http://www.nrc.gov/reactors/new-licensing/license-reviews/esp.html.

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