PERMITTING CHALLENGES FOR THE NEW GENERATION OF NUCLEAR POWER PLANTS

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1.0 INTRODUCTION

The electric power industry in the United States is continuing to face an unsettled environment, marked by unprecedented high fuel (natural gas) prices, increased regulatory requirements on emission controls and waste management, security and non-proliferation issues (radiological materials), global warming concerns, and deregulation of the industry. In response to this environment, the Bush administration's National Energy Policy calls for expanding nuclear energy in order to meet the future power demand and maintain energy security. The Department of Energy's (DOE) Nuclear Power 2010 initiative is also supportive of building new nuclear plants in the coming decade.

Implementing the regulatory demonstration activities specified in Nuclear Power 2010 is an important first step toward achieving the expanded use of nuclear energy. Demonstrating the effectiveness and flexibility of early site permitting represents the first key regulatory activity in this initiative.

Last year, three electric utility companies announced their intention to proceed with a DOE/industry cost-sharing demonstration project – the Early Site Permit (ESP) application. Formal submittals of these three ESP applications to the NRC are planned for the third quarter of 2003.

This paper discusses the applicable regulatory process and the challenges for securing an ESP in the current regulatory environment. The discussions focus on re-defining a "Region Of Interest" for selection of candidate power plant sites, implementing methodologies which maintain flexibility in the proposed reactor technology, and utilizing existing facility information and infrastructures as the basis for sound decision-making on site suitability.

2.0 APPLICABLE REGULATORY PROCESS

The nation's fleet of existing commercial nuclear power plants were licensed under the Nuclear Regulatory Commission (NRC) process commonly referred to as "Part 50" (Figure 1). The major difficulty in the Part 50 approach was that siting, design, and safety issues were often not fully resolved until after substantial investment had been made and the plant design essentially complete. The NRC's new regulation, Part 52, has the potential to resolve these issues by providing early resolution of siting and design issues prior to commencement of construction, presumably enhancing the stability and predictability of the regulatory review and approval process.

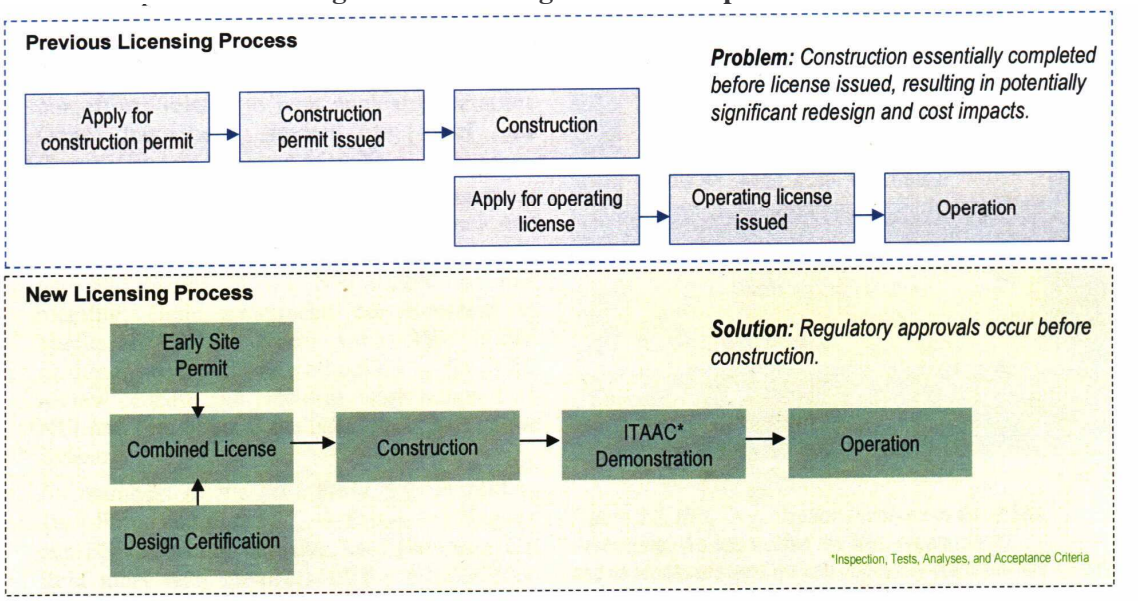
Under Title 10, Energy, Code of Federal Regulations (10 CFR), the new Part 52 process consists of three major components:

- Design Certification – NRC approval of the nuclear facility design.
- Early Site Permitting – NRC approval of the site.
- Combined License – NRC issuance of a combined construction permit and conditional operating license.

Of the three major licensing processes under Part 52, only one has been demonstrated to date - the design certification process.

Figure 1 provides a comparison of the previous Part 50 and the new Part 52 Licensing Process, which is more effective and flexible, and ensures the up-front involvement of all stakeholders.

Figure 1 Licensing Process Comparison



3.0 CHALLENGES IN PREPARING AN EARLY SITE PERMIT (ESP) APPLICATION

A valuable feature of the Part 52 process is that an ESP is intended to demonstrate the suitability of the site for construction and operation of a nuclear power plant, not the acceptability of a particular plant design.

Subpart A of 10 CFR Part 52 provides the requirements for an ESP. The complete ESP application does have to meet NRC requirements and guidance and any deviations from these requirements and guidance may add to the complexity and impact to the permitting review and approval process, as well as schedule.

3.1 Major Parts of the Application

Based on the requirements in 10 CFR 52.17, an ESP application can be divided into four major parts:

- Part 1. Administration Information - Provides an introduction to the application and its subparts.
- Part 2. Site Safety Analysis Report (SSAR)- Describes the features of the new reactor design that interface with the site, identifies the capabilities of the design to withstand environmental and man-made hazards, and evaluates the expected and potential impacts of the design on the site.
- Part 3. Environmental Report (ER)- Describes the environmental effects of construction and operation of the new reactor facility and evaluates alternatives.
- Part 4. Emergency Response Plan - Provides a complete and integrated Emergency Response Plan for the new reactor facility.

The following discussions focus on the technical areas where regulatory guidance is not provided or the referenced regulatory guidance is not applicable for preparing the SSAR and the ER of an ESP application.

3.2 Format And Content / Guidance Documents

Although the NRC believes the Part 52 licensing process is ready for use, there is no regulatory guidance document that specifically describes the format and content of an ESP application. Guidance for applicants on an acceptable approach for implementing the requirements for 10 CFR Part 52 Subpart A can be found in the *Industry Guideline For Preparing An Early Site Permit Application – 10CFR Part 52, Subpart A (Application Guide).* The industry Application Guide provides applicants with detailed descriptions of the content, format, and legal requirements for the ESP application.

A draft RS-002 Nuclear Reactor Regulation (NRR) Review Standard (RS), regarding processing applications for ESP, was issued by NRC in December 2002, for interim use and public comment. The objective of this review standard is to ensure that staff reviews of applications for ESP and the associated environmental reports are effective, efficient, and consistent, and that the reviews result in high-quality products. To the extent feasible, the ESP RS-002 clearly defines guidance and acceptance criteria for the staff to use to support a Commission determination on whether or not an ESP should be issued.

The format and content of the ESP applications currently being prepared by the three utility companies, closely follow the format and content requirements provided in two NRC guidance documents: NUREG-0800, *Standard Review Plan for the Review of Safety Analysis Reports for Nuclear Power Plants* and NUREG-1555*, Environmental Standard Review Plans.* These two guidance documents are part of the regulatory basis for the draft RS-002.

3.3 Plant Parameter Envelop – A Technology Neutral Approach

Since an ESP is valid for 10 to 20 years and may be renewed for another 10 to 20 years, the goal of an ESP is to produce an approved site for the future development of a nuclear power reactor, without identifying a specific reactor technology.

The set of parameters that are used to characterize a facility for selecting a site and developing an ESP application is called a Plant Parameters Envelope (PPE). The concept and the PPE used to define the plant-site were developed in the early 1990s based on work sponsored by the DOE and the nuclear industry, including reactor vendors and utilities. The effort was intended to provide a comprehensive list of plant parameters that accurately characterize a plant's requirements and

impacts at an undefined site. Over time, the PPE listing has evolved to encompass a variety of information needed to support development of an ESP application.

A PPE can be developed for a group of candidate facilities by selecting the most limiting parameter values among the group. The broader the envelop of candidate design characteristics represented in a composite PPE, the greater the conservatism.

To ensure that future reactor types can be included on an ESP site, an overall and bounding PPE should be developed based on the attributes and needs of current and near-term nuclear technologies. The design concepts of these technologies differ by developer, but are all generally influenced by the following factors:

- The need for improved economic performance.
- Advanced safety, with increased reliance on passive safety concepts.
- Progress toward a solution for disposal of high-level waste.
- To a lesser extent, non-proliferation.

The current advanced nuclear power plant designs for which developers have either applied for, or are expected to apply for, review by the NRC are listed below:

- Advanced Boiling Water Reactor manufactured by General Electric (ABWR)
- Enhanced Simplified Boiling Water Reactor being developed by General Electric (ESBWR)
- AP-1000 Pressurized Water Reactor developed by Westinghouse Electric Company
- ACR-700 Light Water Cooled reactor developed by Atomic Energy Canada Limited
- International Reactor Innovative and Secure (IRIS) next generation Pressurized Water Reactor being developed by a consortium led by Westinghouse Electric Company
- Pebble Bed Modular Reactor (PBMR) being developed by PBMR (Pty) Ltd.
- Gas Turbine Modular Helium Reactor (GT-MHR) being developed by General Atomics.

The following presents a case study on how the PPE concept was applied in a recent ESP application.

In order to assure that the resulting PPE has the flexibility to envelop multiple reactor designs, these seven designs shown above were selected to provide a broad cross section of available reactors. In addition, to assure that the data presented in the PPE was adequate to envelop multiple plant designs, the same set of information was requested from the vendors of these designs. That information was compiled and bounding plant parameters were defined. The bounding parameters were selected as the single largest (or smallest) value for each category, based on engineering, safety and environmental conservatism.

The PPE is not intended to be limited to these seven designs only, but rather to provide a broad overall outline of a design concept and to include other potential designs if they can be demonstrated to fall within the parameter values provided in the PPE.

3.4 Alternative Sites Review

The objective of the alternative site evaluation is to verify that there are no “obviously superior sites” for the eventual construction and operation of a new nuclear plant.

As defined in NUREG-1555, the "Region of interest" (ROI) is the geographic area under consideration for selection of candidate sites for new nuclear generation. The ROI generally includes the state in which the proposed site is located, and/or the relevant service area for the proposed plant. "Candidate sites" are those sites that are within the ROI that are judged to be, from a comparative evaluation of sites, among the best that can reasonably be found for the siting of a nuclear power plant. "Alternative sites" are those candidate sites that are specifically compared to the proposed site to determine if there is an obviously superior site.

Prior to deregulation of the power industry, alternative sites were typically located within a utility's ROI, usually its service territory. Under deregulation, there is no regulatory structure in place to guarantee a return on investment and many of the decisions affecting the location of new plants are based on factors such as cost, ease of construction, and the ability to transmit the power to customers. The new power facility will have to operate in the competitive marketplace created by the Energy Policy Act of 1992 and subsequent actions by the FERC that impose open transmission requirements. These changes have fundamentally altered both the marketplace for electricity and the makeup of electricity generating companies. Thus, the decision for an ESP site is fundamentally a business decision, yet one that still must satisfy energy demands. This concept differs significantly from the NUREG-1555's definition of ROI and its guidance regarding the identification of candidate sites as alternatives to the proposed site.

The candidate site criteria described in NUREG-1555 are as follows:

- Not pose significant issues that would preclude the use of the site for a nuclear power plant.
- Not cause significant impacts or degradation of local natural resources on the site that would be created.
- Not pose significant impacts to surrounding terrestrial and aquatic ecosystems.
- Not to be located in proximity to major population centers.
- Not affect site development costs significantly when compared to the alternative site(s).

In developing a list of reasonable candidate sites, the initial review usually includes evaluation of multiple categories of sites including undeveloped sites (commonly known as "greenfield"), previously developed sites (commonly known as "brownfield"), federal facility sites, and existing nuclear power plant sites within the identified ROI. The federal sites are considered under the assumption that such sites could accommodate new reactor technologies. The use of existing nuclear power plant sites for new power generation have many obvious environmental and cost benefits. The review of generic greenfield and brownfield sites is made to ensure that there are no sites obviously superior to the proposed site.

A generic greenfield site, or to a lesser extent a brownfield site, is generally not considered to be a reasonable candidate site for the following environmental reasons:

- A large land area will need to be disturbed to build the new plant, which may cause large land use, ecological resources, aesthetics, and local transportation network adverse impacts.
- New transmission lines and corridors may be needed to connect the new plant to the existing power grid, and local transportation routes and access roads may need to be built or upgraded. Such improvements could lead to additional land use, ecological, and aesthetic impacts.

- Sites in remote areas within the ROI may not have sufficient water resources and local transportation network to support a large power plant.
- The socioeconomic impacts associated with plant construction and operation would be large for sites in rural areas due to the number of transient construction workers that would have to move into the area.
- Site development costs for a greenfield site are substantial, especially with regard to building the required infrastructure and conducting the site characterization studies.
- Finally, community acceptance of a new nuclear power plant in an area that is not familiar with its operational record is an unknown factor, which may impact the ability to finance a project.

3.5 Optimum Utilization Of Existing Information And Infrastructures

The special case provision noted in NUREG-1555, ESRP 9.3 (Subsection III(8)) states that a new facility can be located at an existing nuclear power plant site that was previously found to be acceptable from a National Environmental Policy Act (NEPA) review, and/or that had satisfactory environmental operating experience.

There are obvious benefits offered by locating a new nuclear power plant at an existing nuclear site, as opposed to a non-nuclear site. These benefits are summarized as follows:

Environmental Benefits

- The environmental conditions and the environmental impacts of an existing nuclear station are assumed to be well known and adequately documented based on years of monitoring air, water, ecological, and other parameters.
- Construction of new transmission corridors and the associated adverse environmental impacts and land acquisition processes may be avoided assuming the existing transmission system (lines and corridors) can accommodate the increased power generation.
- The existing site has already been subjected to the alternative review process mandated by NEPA.
- Extensive environmental studies have been performed during the original site selection process, which could be updated and used to support development of the new plant.

Constructability and Cost Benefits

- Site physical criteria, including primarily geologic/seismic suitability, have already been characterized at existing nuclear sites.
- If the existing site can accommodate the new plant and the transmission line systems do not need to be upgrade, no additional land acquisitions are necessary.
- Plant construction, operation, and maintenance costs are reduced because of existing site infrastructure (e.g., roads, transmission lines, water source, intake/discharge system).

Other Benefits

- The existing sites have nearby power markets.
- Existing nuclear plants are likely to have gained local community acceptance and support.

- Existing nuclear sites have personnel having relevant nuclear experience.

4.0 CONCLUSIONS

The key feature of the ESP process is that it provides a way to demonstrate the suitability of a site for construction and operation of a nuclear power plant without having to define and evaluate the acceptability of a particular plant design.

Composite PPEs are used to describe a range of plant types and to use the most limiting value for each parameter. This overall and bounding PPE approach, based on a spectrum of advanced nuclear power plant designs, enables an ESP site to be approved for the future development of a nuclear power reactor without identifying a specific reactor technology. The amount of conservatism inherent in the composite PPE may have implications regarding the selection and suitability of specific sites as well as the applicability of the ESP once the actual facilities are selected. Thus, this PPE approach may lead to generation of a restrictive and costly plant designs. Consequently, the determination of the PPE must take engineering, economic and environmental consequences into consideration.

The concept of defining the "Region-Of-Interest" to support identification of candidate sites and alternative sites in the ESP application is significantly different from that envisioned in NUREG-1555. Since the decision for an ESP site is fundamentally a business decision. NRC acceptance of the new concept could add new uncertainties to the permitting process.

Although a special case provision is provided in NUREG-1555 that allows a new proposed facility to be developed at an existing nuclear power plant site, justifications must be fully prepared to support the site proposal. Since an existing nuclear power plant site has been previously found to be acceptable from a NEPA review perspective, the permitting process for a proposed site at an existing nuclear plant site should be streamlined, assuming the existing plant has demonstrated satisfactory environmental operating experience.

Finally, summary reports to DOE that document the lessons learned, resource requirements, recommended changes to industry and NRC guidance, and other related comments regarding the ESP demonstration process are expected from each of the three ongoing ESP projects in the near future.

REFERENCES

- 10 CFR Part 50, "Domestic Licensing of Protection and Utilization Facilities"
- 10 CFR Part 52, "Early Site Permit, Standard Design Certification, and Combined Licenses for Nuclear Power Plants."
- 10 CFR Part 52 Subpart A, "Early Site Permit Application"
- 10 CFR 52.17, "Contents of application"
- National Environmental Policy Act (NEPA)
- NUREG-0800, "Standard Review Plan for the Review of Safety Analysis Reports for Nuclear Power Plants", U.S. Nuclear Regulatory Commission, July 1981
- NUREG-1555, "Standard Review Plans for Environmental Reviews for Nuclear Power Plants", U.S. Nuclear Regulatory Commission, October 1999
- NRR Review Standard, RS-002, " Processing Applications for Early Site Permits", draft for interim use and public comment, U.S. Nuclear Regulatory Commission, December 2002
- Nuclear Energy Institute (NEI), NEI 01-02, "Industry Guideline For Prepare An Early Site Permit Application – 10 CFR Part 52, Subpart A", September 2001