U.S. Department of Energy

Report on Lessons Learned
from the
NP 2010 Early Site Permit Program

FINAL REPORT

Prepared by
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March 26, 2008

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B. *Early Site Permit Demonstration Project Lessons Learned*, Entergy Nuclear, Inc., August 23, 2007 ..... B-1

C. *North Anna Early Site Permit Project Summary Report*, Dominion Nuclear North Anna, LLC, February 2008 ..... C-1

EXECUTIVE SUMMARY

This report provides a summary of lessons learned from the demonstration of the licensing process for three Early Site Permit (ESP) applications supported as part of the Department of Energy's (DOE) Nuclear Power 2010 (NP 2010) program. The ESP process was established by the Nuclear Regulatory Commission (NRC) to enable completion of the site evaluation component of nuclear power plant licensing under 10 CFR Part 52 before a utility makes a decision to build a plant. Early Site Permits are valid for 10 to 20 years and can be renewed for an additional 10 to 20 years. NRC review of an ESP application addresses site safety issues, environmental protection issues, and plans for coping with emergencies. Successful completion of the ESP process will establish that a site is suitable for possible future construction and operation of a nuclear power plant. Most importantly, an ESP resolves significant site-related safety and environmental issues early in the decision process and helps achieve acceptance by the public.

DOE competitively selected Dominion Nuclear Energy North Anna, LLC (Dominion); System Energy Resources, Inc. (an Entergy subsidiary); and Exelon Generation Company, LLC (Exelon) in 2002 to demonstrate the ESP process and provided cost-shared support through the NP 2010 program. Dominion pursued an ESP for the North Anna site in Virginia; System Energy Resources, Inc. pursued an ESP for the Grand Gulf site in Mississippi; and Exelon pursued an ESP for the Clinton site in Illinois. After successfully demonstrating the process, the NRC issued an ESP for Clinton on March 17, 2007; Grand Gulf on April 5, 2007; and North Anna on November 27, 2007.

As with all successful projects, there are lessons to be learned from the NP 2010 early site permitting demonstration that can help improve future implementation guidance documents and regulatory review standards. In general, these lessons pertain to the effectiveness of the regulatory process, experience related to guidance for developing and reviewing ESP applications, issues involving ESP plant parameters, and suggestions for future ESP applicants.

The development, submittal, and issuance of these first ESPs under DOE's NP 2010 program started the momentum to exercise NRC's new 10 CFR Part 52 licensing process. Several key questions that define critical issues regarding the effectiveness of regulations pertaining to ESPs have been identified and summarized in this report. However, the final resolution of whether the ESP component of the Part 52 process significantly contributes to the predictability in nuclear power plant licensing requires more experience and time, such as the completion of the ongoing combined Construction and Operating License (COL) process for the North Anna and Grand Gulf sites.

The three ESP project participants prepared and submitted to DOE lessons learned reports from their experience in developing, submitting, and receiving an ESP. This document summarizes these reports, which are appended hereto. The Nuclear Energy Institute (http://www.nei.org/) and NRC (http://www.nrc.gov/) have also prepared reports regarding their perspectives on lessons learned during the ESP process. Their documents can be accessed on their respective web sites.

Following is a summary of the lessons learned from the NP 2010 ESP projects.

Effectiveness of the ESP Process: In general, the ESP process is expected (subject to demonstration of the ESP finality provisions in the North Anna and Grand Gulf ESPs) to provide high value for applicants as a site banking and risk mitigation strategy. However, several aspects of the initial process, such as NRC hearings and determining an acceptable approach to the NRC's Emergency Planning requirements, proved challenging for the applicants.

Project Execution: Initial regulatory and industry guidance for planning and executing an ESP application program proved to be insufficient to address NRC's document review expectations. However, continuous communication between NRC and the applicants helped establish an acceptable framework for the applications and resulted in the successful issuance of three ESPs. Still, formal guidance from both NRC and industry is needed for issues involving merchant plants; data collection issues; and interactions between NRC, the public, and the applicants.

Specific Plant Parameter Issues: The use of the Plant Parameter Envelope (PPE) approach, when the applicant has not yet chosen a reactor technology, proved to be a major source of confusion between applicants and NRC. This issue had also been a topic of discussion during the NRC ESP hearings. Based upon North Anna and Grand Gulf COLA experiences, the need should be evaluated for future NRC guidance pertaining to the PPE approach to clarify these issues. In addition, NRC, applicants, and industry spent considerable time and resources deciding how to employ new seismic analysis approaches. Future guidance in this area would also be very useful.

Best Project Practices: A variety of good practices were identified, such as using specific project tracking and milestone items, handling very large documents electronically, employing a formal and rigorous document review process, and sharing large files across organizational sites.

This report also includes a set of general recommendations to assist future ESP applicants. Several recommendations highlight the need for NRC and industry to continue to work together to improve the ESP process.

1. INTRODUCTION

1.1 Background

New baseload nuclear generating capacity is required to enhance U.S. energy supply diversity and energy security, a key *National Energy Policy* (NEP)[1] objective. The Nuclear Power 2010 program (NP 2010), unveiled by the Secretary of Energy on February 14, 2002, is a joint government/industry cost-shared effort to identify sites for new nuclear power plants, develop and bring to market advanced nuclear plant technologies, evaluate the business case for building new nuclear power plants, and demonstrate untested regulatory processes. In addition, NP 2010 is focused on reducing the technical, regulatory, and institutional barriers to deployment of new nuclear power plants based on expert recommendations documented in *A Roadmap to Deploy New Nuclear Power Plants in the United States by 2010*[2].

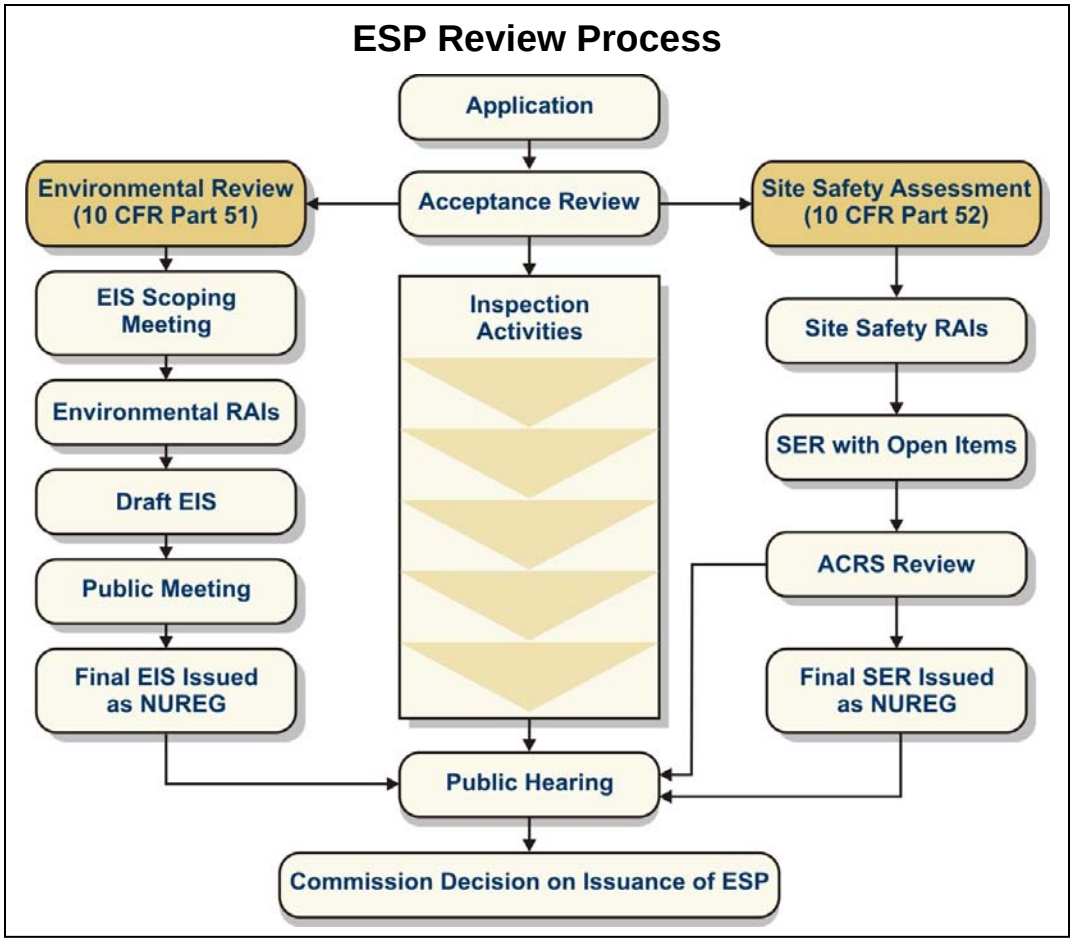
To enable the deployment of new nuclear power plants in the United States in the near term, it is essential to demonstrate the untested 10 CFR Part 52 Federal regulatory and licensing processes for siting new nuclear plants, the Early Site Permit (ESP). This is one of the key licensing demonstration efforts of the NP 2010 program.

NRC established the ESP process to enable completion of the site evaluation component of nuclear power plant licensing before a utility makes a decision to build a plant. Early Site Permits are valid for 10 to 20 years and can be renewed for an additional 10 to 20 years. The NRC review of an ESP application addresses site safety issues, environmental protection issues, and plans for coping with emergencies, independent of the review of a specific nuclear plant design. Successful completion of the ESP process can resolve many site-related safety and environmental issues and determine if a site is suitable for possible future construction and operation of a nuclear power plant. Figure 1 provides a flowchart of the major milestones associated with the ESP process.

In March 2002, DOE issued a solicitation inviting U.S. nuclear utilities and generating companies to demonstrate the ESP process. Dominion Nuclear North Anna, LLC (Dominion); System Energy Resources, Inc. (an Entergy subsidiary); and Exelon Generation Company, LLC (Exelon) were competitively selected by DOE in 2002 to undertake three ESP projects. Dominion would pursue an ESP for the North Anna site in Virginia; System Energy Resources, Inc. would pursue an ESP for the Grand Gulf site in Mississippi; and Exelon would pursue an ESP for the Clinton site in Illinois.

The scope of this demonstration included preparing and submitting an ESP application to NRC and supporting NRC review to obtain the ESP. The demonstration was conducted

[1] National Energy Policy, Report of the National Energy Policy Development Group, May 2001
[2] A Roadmap to Deploy New Nuclear Power Plants in the United States by 2010, US Department of Energy, October 31, 2001



on a cost-shared basis, with the applicant providing a minimum of 50 percent of the total cost of their project.

The NP 2010 ESP cost-share effort followed the three ESP applications through to the successful issuance by NRC of the ESP for each application. The Clinton project was issued its ESP by NRC on March 17, 2007; Grand Gulf followed on April 5, 2007; and North Anna was issued its ESP on November 27, 2007.

1.2 Purpose of the Lessons Learned Report

The focus of this report is on the lessons learned from the first phase of the NP 2010 program; namely, the ESP process.

As part of the requirements under its NP 2010 cost-share program with Dominion Energy, Inc., Entergy Nuclear, Inc., and Exelon Corporation, DOE required a lessons learned report for each project. The lessons learned were to address the preparation and NRC review of the respective ESP application. Each ESP lessons learned report was submitted to DOE. The purpose of this report is to consolidate

and organize the lessons learned and suggest follow-up actions to address important issues.

2. LESSONS LEARNED

The lessons learned reports submitted by the ESP NP 2010 participants contained many useful and detailed analyses and recommendations recorded during the ESP development, review, and approval cycles. There are a variety of technical issues in these reports that were identified and resolved in the respective ESP process, which are not discussed in this report. However, the original reports are appended in their entirety as part of this final DOE Lessons Learned Report. This report summarizes and highlights significant issues raised by three participating utilities.

2.1 Types of Findings

To consolidate the lessons learned, findings were organized into several broad categories: 1) general comments on the effectiveness of the ESP process, 2) specific experiences involving implementing processes for ESP application development and review, 3) issues involving ESP plant parameters, and 4) suggestions or noted best practices for future ESP applicants. Following are the major findings in each category. To assist the reader, the sources of these findings are referenced to the specific reports noted in Section 5 of this report as follows: (CLT) - Clinton Report in Appendix A; (GG) - Grand Gulf Report in Appendix B; and, (NA) - North Anna Report in Appendix C.

2.1.1 Effectiveness of the ESP Process

1. In general, the utilities concluded that the ESP process has high value for applicants as a site banking and risk mitigation strategy. Pursuing an ESP may be most useful for applicants who have selected a site but have not yet finalized their choice of technology and/or applicants who are not prepared to enter fully into the COL process (GG, NA).

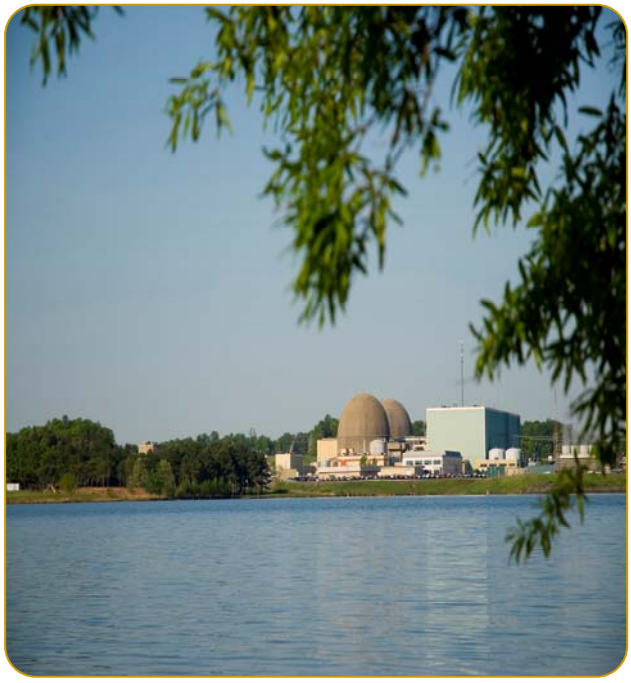
2. For greenfield sites, the ESP process may be especially useful for those utilities that wish to have an NRC assessment of a site for use in the future (GG, NA).

3. Utilities believe that an ESP reduces an applicant's risk, especially monetarily, by mitigating future COL licensing delays and certain regulatory uncertainties (CLT, GG, NA).

4. The experiences of applicants before NRC's Atomic Safety and Licensing Board (ASLB) were varied, but there is clearly a need for better understanding on the expectations for the ESP ASLB hearings. In addition, issues dealing with the need for mandatory hearings for non-contested cases are the subject of ongoing work between industry and the NRC staff (CLT, GG, NA).

5. As part of the ESP process, issues involving the adequacy of submitting "major features" pertaining to Emergency Planning (EP) were identified. The benefits of the "major feature" approach have not been discernable, and the resulting impression is that covering EP issues at the combined Construction and Operating License Application (COLA) stage results in work being done twice with no real benefit. However, when the ESP pertains to a greenfield site, the early identification of EP issues may be beneficial (NA, GG).

6. The timeframes for NRC's North Anna, Clinton, and Grand Gulf ESP application reviews ranged from 41 to 50 months. NRC estimates that the more recent Vogtle ESP application will be completed in 37 months (25 months for ESP review and 12 months for the mandatory hearing process). This is encouraging, and NRC's efforts to further streamline its environmental processes may further reduce review times (NA).



North Anna Nuclear Power Station at the Dominion Energy North Anna site in Virginia

7. NRC provided, at least in one case, its technical position on an issue as part of the Final Safety Evaluation Report (FSER). It is not clear how NRC technical positions (e.g., calculating snow loads) are carried forward into regulatory guidance (NA-Table 2 #8).

2.1.2 ESP Project Execution

1. Regulatory and industry guidance for planning and executing an ESP application program were found to be inadequate with regard to:
    a. Incorporating the Plant Parameter Envelope (PPE) approach, including how to handle non-certified reactor designs (CLT)
    b. Developing an ESP for a non-regulated (i.e., merchant) plant versus a traditionally regulated plant (i.e., difficulties arose in addressing alternative site analyses and transmission line issues involving merchant plants) (GG-#3, NA-Table 2 #7)

c. Addressing existing versus greenfield sites (e.g., the use of data from an existing licensed plant versus less detailed data for greenfield sites) (CLT)

d. Applying quality assurance (QA) requirements for data derived from original licensing documents and operation programs for existing plant sites, data from industry sources (e.g., EPRI seismic data/analyses), and plant design data used in developing the PPE provided by vendors (GG, NA)

Clinton Nuclear Power Station at the Exelon Clinton site in Illinois

2. The use of existing plant data appears to avoid the need for full, 24-month, pre-application data collection. However, inherent in using existing site data is the need to demonstrate that the existing data is compatible to the characteristics of the new plant configuration (e.g., plant footprint and intake and discharge locations) (GG).

3. In its review of one ESP application, NRC staff undertook a review of existing plant license conditions; the applicant had not expected this and considered that the reliance for the ESP on an existing licensing basis condition and requirements would be taken as an acceptable approach (GG-#12).

4. Applicants had some difficulties understanding the public interactions in the NRC ESP process, especially in terms of timing and expectations. Some of this confusion resulted from having separate NRC project managers for the environmental and safety reviews (GG-#14).

5. Differences existed in the way NRC processed its requests for additional information (RAIs). Specifically, RAIs generated by the safety technical staff included identifying draft RAIs, conducting applicant and NRC staff discussion of the draft RAIs, and then finalizing RAIs by the NRC staff. On the environmental

side, such communication and interactive efforts were not always in place (NA- Table 2 #16). NRC has developed a new electronic RAI process that should standardize these interactions for the ESP, COL, and DC (Design Certification) applications.

6. In Advisory Committee on Reactor Safeguards (ACRS) briefings concerning the ESP applications, committee members noted the need to have more data and studies on longer term weather cycles. This should be addressed as part of ongoing NRC and DOE cooperative research efforts (CLT).

7. Pre-application visits by NRC to applicant sites were very beneficial to all parties: applicants, NRC staff, other affected agencies, and the public. These visits provided multiple opportunities to ask questions and provide feedback for all concerned parties in the ESP process (CLT, GG, NA).

8. Changes to submitted ESP applications were necessary as the ESP process evolved. Both ESP and COLA applicants should have change control processes and publication tools in place to address the need for document revisions. When responses to the NRC staff's RAIs require changes to an applicant's documentation, robust change control programs become even more imperative (NA).

9. ESP applicants, at times, relied on data gained from the internet (e.g., socio-economic and population data trends and historic/cultural data). The quality requirements for information gained from internet sources are undefined and require attention from NRC and industry (CLT, NA).

2.1.3 Specific Plant Parameter Issues

1. In general, as the initial ESP applications and reviews evolved, the PPE approach appeared to be useful; NRC and industry should continue to support its use. It should be noted that the PPE approach may defer final resolution of certain design features to the COL stage, such as the adequacy of intake and discharge structures design (NA).

2. The initial use of the PPE approach and the relationship of this approach to existing regulations and guidance were not clear (e.g., 10 CFR Part 52, 10 CFR Part 100). Following is an overview of specific areas of the guidance that needed clarification between the applicant and NRC (GG):

    a. Use of bounding analyses for environmental impacts (i.e., qualifying the site for a specific level of impact versus the impact of a specific plant design)

    b. Need under NRC regulations to provide specific radiological consequences analyses

c. Limiting the use of the PPE approach for certain environmental issues because of lack of site-specific design information (e.g., intake and discharge structures and storm water systems)

Grand Gulf 1 Nuclear Power Station Cooling Tower at the Entergy Grand Gulf site in Mississippi

3. Logistics for obtaining data from vendors and the quality consistency of data obtained were problems for the initial ESP applicants (GG, NA).

4. A high level of interaction among the Nuclear Energy Institute (NEI), the Electric Power Research Institute (EPRI), and the applicants was necessary to ensure full understanding of the methods, assumptions, and results of the relatively new seismic analysis approaches (GG, NA).

2.1.4 Identified Best Project Practices

1. Mandatory ESP section briefings from the very early stages of ESP document development need to be listed as project milestones.

2. Detailed planning and scheduling, action items lists, and weekly project schedule meetings will ensure early identification of problem areas and schedule impacts.

3. The practice of “pre-job briefings” will add value to certain planned activities, such as performing complex calculations needed to support the COL application.

4. "Team Review" of the completed draft document will serve to improve the consistency of language and approach to multiple sections of the ESP document.

5. Use of desktop publishing and professional word processing applications will be required for the very large electronic documents associated with the ESP application.

6. Use of a File Transfer Protocol (FTP) site or other means to exchange or store large electronic files will be necessary and will prove to be extremely useful.

3. SUGGESTIONS FOR FUTURE ESP APPLICANTS

In reviewing the experiences encountered in completing the three ESP projects, the following advice was developed with the hope that it would provide useful guidance to future ESP applicants:

1. Be ready to adjust! Project teams need to periodically re-evaluate responsibilities and make adjustments based on experience of project individuals, workloads, and other factors.

2. Engage NRC at the earliest opportunity about application plans to permit NRC to factor in their budgeting process resources for upcoming reviews.

3. Have intermediate scheduled milestones for complex documents like ESP and COL applications and make sure they are met. Otherwise, delays in application sections result in having too many sections being reviewed and approved at the end of the schedule.

4. Have specific project schedule entries and target dates for each calculation/analysis that must be performed to support the ESP and/or COL application, including origination and checking and approval steps.

5. Stay proactive in providing information at the outset sufficient for NRC and other state and Federal regulatory agencies to make their required findings. Engage all parties such as State and other Federal permitting agencies early and often and take the necessary steps to obtain needed permits and/or certifications early in the application process.

6. Assume that state and local regulatory agencies are not familiar with the NRC nuclear licensing process. Make sure that the project includes significant background information and support to these agencies.

7. Have quality assurance (QA) requirements meeting 10 CFR 50, Appendix B, in place prior to data collection and/or analyses. Make sure the project team has a clear understanding of QA requirements for each data set used in the ESP application, including those derived from the internet. In addition, make sure all documents used satisfy license QA requirements.

8. Ensure that there are ample candidates for the alternative site analysis section of the ESP application. Limiting the analysis to two or three may not be sufficient.

9. Charge a single organization with the responsibility for performing the alternative site selection methodology to ensure consistency of application.

10. Have early and multiple site visits by regulatory entities; this proved extremely valuable from information and cost estimating perspectives.

11. Use existing site information with care. Ensure there are no updated data and that all assumptions are clearly documented.

12. Ensure that all ESP team members have training on the ESP process and project management requirements. Training will be needed on all applicable regulatory requirements, including environmental decision standards.

13. Include commitments related to permits, both for operation and pre-construction activities, in the ESP applications.

14. Ensure that there are processes and agreements in place for the receipt of quality data from reactor vendors, which are relied upon as part of the ESP application.

4. GENERAL RECOMMENDATIONS

Much has been learned by industry and NRC with the completion of the three demonstration ESP projects. NRC and industry should continue to work together to improve the implementation of the ESP process. The five subsections below provide recommended areas where such continued work would be most useful.

4.1 PPE Approach

Considerable interaction between NRC and applicant staffs was required to establish common expectations and understandings on the PPE approach. This issue had also been a topic of discussion during the NRC ESP hearings. The PPE, or "reactor technology neutral," approach was intended to assist ESP applicants not having a specific reactor design. It is unclear if the existing NRC guidance for ESP applications sufficiently addresses expected level of details needed to adequately use the PPE approach for future

ESP applications. This is especially relevant regarding cases where exact size of reactor footprint is not accurately known.

Based on North Anna and Grand Gulf COLA experiences, the need should be evaluated for future NRC guidance pertaining to the PPE approach to clarify these issues. For example, guidance may be helpful on using the PPE approach when the range of facilities considered consists of specific designs that are the subject of reference COLAs.

4.2 Interfaces with the Public

For issues involving interactions with the applicant and the public as part of the NRC ESP process, it may be helpful to the NRC to have a single point of contact for all meetings rather than relying on two different contact points—the environmental project manager or the safety project manager.

4.3 Regulatory Guidance

Industry and NRC should continue to work together to enhance ESP application guidance that incorporates lessons learned from the ESP process.

4.4 From an ESP to a COLA

Specific regulatory guidance to implement the "new and significant" requirements of 10 CFR 51.50(c) (1) has not yet been issued by NRC. Recent COL applicants that have ESPs have undertaken extensive, multi-step processes to meet the "new and significant" standard for COL applications. Based on North Anna and Grand Gulf COLA experiences, the need should be evaluated for additional guidance in this area.

4.5 Employing an Environmental Assessment (EA) for COLAs

For those COLAs referencing an ESP EIS, where NRC concludes no new and significant changes have been identified, NRC should consider what rules or regulatory changes would be required to support the use of an EA rather than an EIS. This may be especially useful and appropriate for COLAs submitted shortly following the granting of an ESP based upon a referenced design.

5. REFERENCES

Final Summary Report, Clinton Early Site Permit Demonstration Project – Lessons Learned, Exelon Generation Company, LLC, December 13, 2007

Early Site Permit Demonstration Project Lessons Learned, Entergy Nuclear, Inc., August 23, 2007

North Anna Early Site Permit Project Summary Report, Dominion Nuclear North Anna, LLC, February 2008

Memorandum from Graham B. Wallis, Chairman, Advisory Committee on Reactor Safeguards, U.S. Nuclear Regulatory Commission (NRC), to Luis A. Reyes, Executive Director for Operations (NRC), on *Lessons Learned from the Review of the Early Site Permit Applications*, September 22, 2006

Lessons Learned from Initial Early Site Permit Experience, NEI 08-03, Nuclear Energy Institute, 1776 I Street N. W., Suite 400, Washington D.C.

APPENDIX A. *Final Summary Report*, Clinton Early Site Permit Demonstration Project – Lessons Learned, Exelon Generation Company, LLC, December 13, 2007

DE-FC07-02ID14412 Exelon Generation Company, LLC
Early Site Permit License Demonstration Project

Final Summary Report 12-13-2007

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OBJECTIVE

DOE has been working with the nuclear industry in an effort to identify the issues and barriers affecting future near-term deployment of new nuclear power plants. DOE has chosen a two-phase government / industry cost-shared project to demonstrate the Early Site Permit (ESP) licensing process. Phase One included the initial scoping and evaluation of two sites compiled into the Site Selection Evaluation Report. As the second phase, EGC will develop and submit an ESP application to the NRC for the Clinton site located in Illinois, fully support the NRC review process and mandatory hearings, and prepare a summary report to the DOE. The Clinton ESP application will be developed using an overall and bounding plant parameter envelope (PPE) that will encompass seven reactor technologies: ABWR, ESBWR, AP-1000, ACR-700, IRIS, GT-MHR, and PBMR.

This report will fulfill the DOE's Final Summary Report requirement of the amended Financial Award. This report summarizes the results of the ESP demonstration project including:

- Cost and schedule information
- Lessons Learned
- Recommended changes to industry guidelines (Specifically, provide to NEI suggested changes to the draft NEI industry guidance document on the preparation of an ESP application, NEI 02-01 to reflect information learned during the course of this project)

Item 1: Cost and Schedule Information

Schedule:

The below "Milestone Status Table" provides a summary of the project activities based on the NRC's final review schedule. The primary issues that impacted the project schedule are discussed below.

Seismic Methodology and Review

The NRC's review was delayed due to the NRC's extended review of the ASCE seismic hazards methodology. The Clinton ESP SSAR seismic evaluation was based on a new methodology that the NRC had not previously reviewed or approved. The NRC developed a seismic supplement to the DSER for the new methodology, and it was issued on August 26, 2005. The final safety evaluation report (FSER) was issued on February 17, 2006 and ACRS committee meeting was held on March 9, 2006. The ACRS submitted its final review letter accepting the ESP application to the Commission on March 24, 2006. The FSER was issued as NUREG 1844 on May 1, 2006

Draft Environmental Impact Statement (DEIS):

The NRC identified a number of DEIS comments for both the Dominion ESP application and the EGC ESP application. Resolution of these comments and subsequent NRC reviews led to the final environmental impact statement (FEIS) being issued as NUREG 1815 on July 28, 2006, a few month later than originally planned.

Table 1: Milestone Status Table:

PROJECTED TASKS	Expected Date	Actual Date
EGC submittal of ESP Application to NRC (Note 1)	09/25/03	09/25/03
NRC publishes Federal Register Notice for receipt and acceptability review	10/17/03	10/24/03
NRC publishes Federal Register notice describing acceptance / rejection of application	11/16/03	10/30/03
NRC publishes Federal Register notice for mandatory hearing	11/16/03	12/12/03
NRC publishes Federal Register Notice for intent / environmental scoping meeting	12/01/03	11/25/03
Petitioner deadline for filing for intervention	12/16/03	01/12/04
NRC Environmental Scoping meeting	12/18/03	12/18/03
NRC 1st QA inspection complete	01/30/04	01/16/04
NRC Environmental Site Visit	03/01-05/04	03/01-05/04
Petitioners file proposed contentions	05/03/04	05/03/04
NRC issues Environmental RAIs to EGC	05/14/04	05/14/04
EGC responds to proposed contentions	05/28/04	05/28/04
NRC responds to proposed contentions	05/28/04	05/28/04
Petitioners reply to EGC & NRC responses (extended to June 9)	06/04/04	06/09/04
ASLB Prehearing Conference on all three ESPs	06/21-23/04	06/21-22/04
ASLB decision on proposed contentions	07/12/04	08/09/04
EGC submits Environmental RAI responses to NRC	07/23/04	07/23/04
NRC issues Safety and EP RAIs to EGC	07/27/04	07/22-27/04
EGC, NRC and Petitioners provide initial discovery information; continuing effort to update as needed	08/11/04	09/07/04
EGC submits Safety and EP RAI responses to NRC	10/12/04	10/12/04
NRC issues Draft SER	02/10/05	02/10/05
NRC issues Draft EIS to EPA; NRC issues notice of availability of Draft EIS	03/04/05	03/02/05
NRC holds public meeting to discuss Draft EIS	03/19/05	04/19/05
EGC submits responses to Draft SER open items	04/26/05	04/26/05
NRC 2nd QA Inspection Complete	05/27/05	05/19/05
EGC, Petitioners and Public comment on Draft EIS	05/25/05	05/25/05

PROJECTED TASKS	Expected Date	Actual Date
NRC optional final QA inspection complete	07/13/05	NA
NRC issues schedule revision	NA	08/16/05
NRC issues Draft SER Supplement (seismic)	05/30/05	08/26/05
ACRS subcommittee meeting on Draft SER	04/04/05	09/07/05
ACRS full committee on Draft SER	05/06/05	09/08/05
ACRS interim letter to Commission	09/28/05	09/22/05
EGC submits responses to Draft SER Supplement open items	10/31/05	10/31/05
EGC submits final Application revision	11/21/05	1/10/06
Commission ruling on Petitioner's contentions	4th Qtr 2005	12/12/05
NRC issues Final SER	02/17/06	2/17/06
ACRS full committee on Final SER	03/09/06	3/09/06
ACRS letter to Commission	03/30/06	3/24/06
NRC issues Final EIS	07/28/06	7/20/06
ASLB initiates hearings	11/7-9/06	11/7/06-11/8/06
ASLB initial decision	01/31/07	12/28/06
Commission decision	05/31/07	05/31/07

Notes:
Tasks and expected dates are based on the NRC web site published schedule and related project correspondence.

Cost Data

[Cost data depicted on this page pertains to Exelon's ESP project specific costs. As such, it is privileged and confidential information exempt from mandatory disclosure pursuant to Exemption 4 of the Freedom of Information Act (FOIA) (5 U.S.C. 552(b)(4)). Accordingly, this cost data on this page has been omitted from the public version of this Report.]

Item 2: Lessons Learned:

Table 4 (attached) provides a listing of "Lessons Learned" for the Clinton ESP project. The table is divided into sections based on the various steps of the project. The breakdown is as follows:

- Site Selection
- Exelon Peer Review of ESPA
- NRC RAIs
- NRC Reviews (Staff, ACRS, ASLB)
- Administrative Issues (e.g., Contractor interface, IT tools)

Item 3: Recommendations to Industry Guidance (NEI 02-01):

The NEI created its ESP Preparation Guidance document, NEI 01-02, because at the time of the commencement of the three initial ESP projects, there was no NRC guidance for ESP applications. At that time, the industry needed a mechanism to initiate conversations with NRC on specific topics. Draft NEI 01-02 served that need.

NEI does not plan to update NEI 01-02 for ESP application guidance because the NRC Staff has committed to updating its ESP Review Guidance, and is evaluating whether to revise RS-002, or the Standard Review Plan (SRP, NUREG 0800) to include the lessons learned from the 3 ESP projects.

NEI contracted Enercon in 2006 to prepare an ESP Lessons Learned report with an eye toward immediately benefiting current COLA applicants. Exelon provided input to this report, and the final draft NEI sponsored ESP Lessons Learned report been issued. This report will be generic, and NEI is considering issuing it as an NEI document.

Based on the above, Exelon does not plan to take further action to seek a revision to NEI 01-02.

Table 4: Lessons Learned

SITE SELECTION EVALUATION

Issue	Lessons Learned / Recommendation
There was an undefined level of detail for the ESP Application due to a lack of guidance documents. In addition, there was a perception of required confidentiality for the project, which precluded open communications with the NRC.	Open communication with the NRC may have helped define the required level of detail regarding the breadth and depth of an ESP Application. This would have increased confidence in estimating cost and schedule. The RGs and NUREGs in place at the time did not contain specific guidance for preparing an ESP Application.
Current NRC regulations and guidance are structured for light water reactor technology. Choice of the gas reactor technology (non certified, non-LWR technology) vs. certified reactor design increased cost/schedule uncertainty.	A reactor neutral approach provides the best flexibility, but this approach was limited by existing NRC regulations and guidance. Updating the NRC's regulatory guidance to better accommodate the PPE approach may be required.
Project was limited to an in-depth, detailed evaluation of only two sites. This limited choice may not provide adequate information for the alternative sites evaluation required for the ESP application.	At least 4 candidate sites should have been examined in detail prior to the commencement of the ESP application so that this information did not need to be developed after commencement of work on the ESP application.
Exelon was responsible for 4 criteria (market projections, socioeconomic, stakeholder, and environmental justice), in parallel with CH2M Hill's evaluation of the remaining EPRI siting guideline-siting criteria. Exelon's evaluations required the acquisition of information and data similar to that gathered for CH2M Hill's evaluations.	Data gathering would have been more efficient if it was performed by one organization. More consistent scoring for site evaluation criteria may have been achievable using one set of data.
Project duration resulted in Tasks 1 and 3 proceeding in parallel. Regulatory requirements and guidance (part of Task 3) were not identified prior to data gathering (part of Task 1).	Economies could have been achieved by simultaneous evaluation of data to Task 1 criteria and Task 3 requirements.
The site visits were extremely valuable from an information gathering and cost estimating perspective. Representatives from both the INEEL and Clinton site were accessible and helpful.	Having early site commitment and a site representative resulted in easy, quick access to valid and appropriate information.

Table 4: Lessons Learned

Issue	Lessons Learned / Recommendation
Inconsistencies and geographical disparity between the sites created some confusion and difficulty in analyzing the data, i.e., - Federally owned INEEL site vs. the privately owned Clinton site - Green field vs. existing nuclear facility - Disparity between access to existing transmission lines (distance from reactor site to nearest transmission lines) - The INEEL site is located in a high desert while Clinton is located in a much wetter region - Resultant disparity in the construction costs associated with these differences. Even though an existing site has its benefits for reducing the cost of preparing an ESP application it may not, over time, be the best location for future construction since existing facility sites have limitations on how much new generation could be installed. Greenfield sites, with access to transmission infrastructure along with greater ESP application costs, could yield the most favorable and flexible conditions for future construction.	The selection of a third site possessing geographical, environmental, and ecological factors somewhere in- between these two sites would have helped with this disparity and provided another set of data for more comparison. The site selection evaluation should evaluate ease of access to the transmission infrastructure five years out along with its projected capacity. This is a critical element that needs to be considered early in the process. This would also require open dialogue with local, state and regional utilities.
The exact size of the reactor footprint was not accurately known. For an accurate estimate on costs, at both sites, an estimated footprint should have been determined. This also resulted in "generalizing" many of the construction costs.	Utilization of a neutral design approach determines a footprint that envelopes all major designs prior to initiating the evaluation.
Some plant parameter envelope criteria may be evaluated differently depending on the type of reactor, which may be difficult to do utilizing a neutral approach.	The scoping criteria should differentiate between those that are reactor design dependent and those that are not. If the data is intended for an ESP application that is essentially reactor design neutral (i.e., bounds a number of designs), the scoping study should reflect a neutral ESP approach. The scoping study should help determine what the ESP approach will look like.
A critical variable in the entire scoping process is the power-marketing factor, especially for a merchant generator. This may be the final determining factor as to whether or not to select a site.	Open communications during the scoping process with stakeholders, congressional delegations, and power companies, may have facilitated or resulted in benefits that may not of otherwise been known. This would include cost sharing of construction, taxes and other benefits.

Table 4: Lessons Learned

Exelon Peer Review

Exelon identified several issues with regards to reference documents used for the development of the ESPA during the peer review.

Issue	Lessons Learned / Recommendation
1) Although authors were willing to supply the reference citation in the Application, they did not, in most cases, retain a copy of the actual reference backup used for the citation. This required an inordinate amount of time to locate all of these references (including backup(s)) approximately one-year after the Application was completed, and provide a hard or electronic copy for Exelon.	Steps were immediately taken to gather all outstanding references. "Screen shots" of all web site information were copied, as were website addresses and dates that material was obtained. Any incorrect references were corrected; those missing were found, or appropriate substitutions were made. These changes were reflected in self-identified changes to the Application. A source documentation form was completed for each reference in the Application. For each Application document (ER, SSAR, etc.,) an electronic folder was created containing all references. An additional folder contained spreadsheets that listed all references and the status of those references in the electronic files (e.g., if reference was provided electronically or in hard copy to Exelon, if Exelon was able to obtain reference, if reference contained in CPS/NRC files). Corrective action measures were written into the vendor Document Creation Guidance Procedure to prevent this from happening in the future.
2) Authors cited websites in the references. Over time, these web sites will change as will the material contained on them and may not match the data in the Application. This required the individuals to go back to the website pages, copy the information into jpeg files to capture it exactly as it was cited in the text. Unfortunately, since a year's time had gone by, some information was not longer available on the website; some websites were no longer functioning; and/or some data had been updated or revised. In addition, the date of the citation was stated as the date the website was accessed. When no backup was kept and the data had to be later retrieved, the access date did not match the earlier cited date.	The quality requirements for information obtained from internet sources are undefined; with growth of internet use, criteria need to be specified.
3) Authors incorrectly cited a reference within another reference (i.e., Williams, 1982 that was originally cited in the CPS USAR Rev. 10) instead of merely citing the CPS USAR Rev. 10. This required CH2MHILL or Exelon to locate those actual references. This happened in several other documents as well as the CPS USAR.	Some over reliance on existing site information / failure to check for updated information (e.g., HMR-55 for precipitation). Assumptions need to be clearly documented.

Table 4: Lessons Learned

NRC RAI RESPONSE

Issue	Lessons Learned / Recommendation
RAI E68-1 was returned from the NRC with concerns regarding source information. Information used to calculate the survey of class size of schools omitted several school districts. Author was asked to recalculate including the missing school districts and that resulted in a lower percentage of schools having a class size at or below the national average. Not all resources were available when the original information was obtained. Not all of the school districts within 50 miles were listed on the website where the information was obtained, although the majority of schools were accounted for.	This issue and its cause were placed on the weekly project teleconference agenda for discussion between participants regarding appropriate action. These actions were documented and communicated to the ESP project staff via a project wide email marked for required reading.
RAI E103-1 was returned from NRC with a concern. CH2M HILL's response to NRC RAI No. 5.3-1 (EGC RAI ID: R3-29) cited an incorrect sentence in the application to be modified. Investigation revealed that there was a difference in the text reviewed by the ER Lead and that of the actual application. Comments and revisions to the application are actually made to a separate file for continuity purposes and this lead to the wrong text being cited in the response.	Task leads were informed and directed to review the actual text of the application to ensure that the correct text is referenced in making changes.

Table 4: Lessons Learned

NRC FSER REVIEWS

Issue	Lessons Learned / Recommendation
Application Format Issues Consistency of the information in the SSAR and ER Application Revisions Site Characteristics Table: ➢ Criteria for identifying Site Characteristics & Controlling Plant Parameter Envelope (PPE) Values in ESP not defined; Plant Parameter Envelope (PPE); Industry wants more appropriate list of parameters Electronic Submission Requirements: Numerous details of guidance not well understood by Applicants or NRC Staff Files size differences between ADAMS and web sites (supposedly resolved) ADAMS file format requirements vs. NRC Staff format requests (supposedly resolved) Resubmit entire application when only one portion is changing	 RS-002 developed after project started; Lessons learned being incorporated into COLA guidance process (DG-1145); NRC considering revisions to RS-002 and / or SRP Guidance was developed to specify requirements for Site Characteristics Table (i.e. "which is which"), and what is required for ESP. The NRC also reviewed its electronic submittals process / capability for possible improvements.
Application Content Issues Multiple technical & licensing guidance were revised / developed during ESPA development: - NUREG/CR-4461 "Tornado Climatology of the Contiguous United States - Branch Technical Position: Winter Precipitation Loads - Proposed Draft 10 CFR Part 52 Rule - 10 CFR Part 100 Requirements (Adsorption & Retention Coefficients, Normal Doses); • Part 100 not written for PPE possibility • Intentions to provide bounding analyses (not understood by NRC) • Need for specific Rad Consequence Analysis (not understood by Applicants)	 ESP review guidance to be updated: ▪ Supplemental RG for seismic methodology ▪ Clarification of EP requirements for major features option ▪ Clarification of where Part 21 / App B required for ESP ▪ Guidance on PPE

Table 4: Lessons Learned

Criteria for maximum flood (PMF) • Significant difference between applicant's Probable Maximum Flood assumption and DSER and FSER. Applicant developed calculations based on existing information • Some information used to support the staff assumptions was anecdotal, giving rise to inaccurate calculations and assumptions by both the applicant and the staff. First of a Kind Review Issues: Performance based methodology for seismic hazards Major features for EP Industry did not expect the level of review for plans based on existing sites Full & Complete Plan option (not understood by Applicants) NRC Major Features Plan review intentions (not understood by Applicants) Applicability of Part 21 / Part 50 App B ➢ Criteria for identifying Permit Conditions and COL Action Items Use of "Reactor Neutral" / PPE Approach difficult; Use of certified design Accident Analysis would have been simpler BUT forces technology selection before ESP NRC regulations geared towards LWR technology Use of PPE results in multiple COL items	Probable Maximum Flood: ➢ Update Regulatory Guide 1.59, "Design Basis Floods for Nuclear Power Plants", which addresses the calculation of the Probable Maximum Flood (PMF); Overly conservative analysis not always best path ➢ Existing information may not be adequate for the purposes of an ESP application. Although existing information may be available, it may be outdated and relied on calculations that were designed for dam safety, not interaction of the PMF with the site. For ESP, calculations should be performed with a consideration of site safety as well as environmental impact of a potential flood on appurtenant structures. Seismic: ➢ Alternative methodologies may be available to meet regulatory requirements ➢ Need to involve NRC early

Table 4: Lessons Learned

NRC EIS REVIEWS
Pre-Application Guidance insufficient:

Issue	Lessons Learned / Recommendation
Early engagement before application	ESP applicants should engage the NRC at the earliest opportunity to ensure that plans can be made to provide resources for the review. Additionally, pre-application discussions are essential to ensure that (1) the scope and duration of monitoring programs to establish site characteristics are likely to meet regulatory expectations and (2) the approach for identifying alternative sites is reasonable.
Understand the decision standards	The ESP applicant's team members should be particularly familiar with the environmental decision standards (environmentally preferable, obviously superior) that the staff will use to compare the proposed site to the alternatives. Interactions during the environmental review, such as during an environmental site audit, are most effective with counterparts who are knowledgeable about the issues and the process.
Data and analysis must support the necessary conclusions	The necessary depth of analysis varies depending on the site-specific environmental setting and environmental resources that may be impacted, but analyses must support the necessary conclusions. Early discussions between the applicant and the staff can help ensure that the data and analyses in the application will adequately support the staff's evaluation.
Content of Submittal Guidance insufficient: Justify applicability of existing information	ESP applicants for sites already in use should consider the wealth of siting information already available and alternative sites that have been considered by the NRC and its predecessor. Nevertheless, the applicability and utility of such information must be established by the applicant for the proposed action.
Clearly document assumptions and mitigation measures	At the COL stage, the applicant must demonstrate that the design selected is bounded by the evaluation performed at the ESP stage to preserve issue resolution, As part of its COL EIS review the staff will evaluate and determine whether the design is bounded by the evaluation performed in the ESP EIS. Therefore, the ESP will include a list of assumptions and mitigation strategies relied upon in reaching the conclusion.

Table 4: Lessons Learned

Issue	Lessons Learned / Recommendation
Include commitments related to permits for pre-construction activities	Include commitments related to permits for pre-construction activities - If the ESP applicant plans to seek authorization to conduct site preparation and limited construction activities under 10 CFR 52.25, then it should consult with the State and with other Federal agencies to determine which permits are required before activities can be performed. Once authorized as part of an ESP, there will be no additional NRC action before a COL application; consequently, a license commitment (which will be converted to a license condition) should be provided in the ESP application.
Other than Light Water Reactors - add challenges that must be addressed.	Certain analyses, such as the impacts of the uranium fuel cycle and transportation of spent fuel and high-level waste have the benefit of generic treatments; see Tables S-3, and since certain reactor types do not meet the entry conditions for use of the generic treatments, interest in other-than-light-water reactors places additional burdens on the ESP or COL applicants to consider and defend such individual and cumulative impacts within the ESP or COL application.
State & local Interface items may not be resolved in a timely manner; Reconcile Concerns of State and Other Federal Agencies Early	Reconcile concerns of State and other Federal agencies early - The ESP applicant should engage other governmental agencies (e. g., State and other Federal permitting agencies) prior to submitting the ESP application to the NRC to discuss and reconcile, if possible, siting issues of particular concern (e.g., water use, transmission line corridor issues),
Resolve Issues Related to CZMA and 401 Certifications Early	Resolve issues related to CZMA and 401 certifications early - A Coastal Zone Management Act certification, if applicable, and a Federal Water Pollution Control Act (Clean Water Act) Section 401 certification are required before the ESP permit can be issued. The ESP applicant should take the necessary steps to obtain certifications early in the application process. If the proposed project is modified during the review process to address, for example, a State concern related to one of these certifications, then it could have an adverse impact on the review schedule.
Application changes / revision management could be improved; Flag Conforming Changes Between the Safety and Environmental Areas	Effective communication is essential between the safety and environmental sides of the review. This applies to both the NRC and the Applicant. The safety and environmental reviews overlap in a number of areas; consequently, a change to the ESP application in response to an environmental RAI can impact the safety side and vice versa.

Table 4: Lessons Learned

Issue	Lessons Learned / Recommendation
Late Changes Could Require Re-Circulation of the Draft EIS	Late changes could require re-circulation of the draft EIS - The NRC discloses the environmental impacts of the project to the public and other Federal and State Agencies in a draft EIS. If the application is modified materially after the draft EIS is issued, then the NRC may have to re-circulate a new draft EIS; this will have an adverse impact on the review schedule.
Minimize Differences Between the ESP and COL Designs	Minimize differences between the ESP and COL designs - The value of the ESP is tied to the early resolution of siting issues and its potential use in a COL. The closer that the design selected at the COL stage is to the surrogate design(s) evaluated during the ESP stage, the more issues will remain resolved at the COL stage; this enhances the effectiveness of the Part 52 licensing process. Use of a plant parameter envelope defers the final resolution of certain design-specific issues to the COL stage.

Table 4: Lessons Learned

NRC ACRS & ASLB REVIEWS

Issue	Lessons Learned / Recommendation
Weather cycling / global warming impact over extended period of ESP.	ACRS needs to formulate a position as to how best to address this topic on a site-specific or regional basis.
NRC staff careful review of the ASCE seismic hazards methodology due to its generic implications.	It is imperative for the NRC and applicants to be prepared and remain current with new methodologies (e.g., seismic and probabilistic risk assessment methodology). Ensure that conclusions are logically supported; maintain a current repository of validated data and documents to support conclusions.
Mandatory hearings required by 10 CFR Part 2. Process not yet well defined; each hearing board requesting different schedules, information, and activities	The ASLB process needs further standardization for consistent reviews of upcoming COLAs. The purpose of an uncontested hearing was questioned by the lead ASLB judge.

Table 4: Lessons Learned

ADMINISTRATIVE ISSUES

Issue	Lessons Learned / Recommendation
Training: Training for the eComment process was conducted in two sessions via conference call (Place Ware) to make team members familiar with the system. Those project team members who weren't able to attend the training were individually trained via telephone.	Interactive sessions lead by project leads using "Placeware", provided both an eComment user's manual and desktop guide for use after training, and continual email or phone support to walk users through any questions they had during or after training.
Accessing the System: eComment was accessed by downloading and installing the eComment Client software, or using an ftp website. Several issues were identified as users accessed the system including: ▪ Exelon users had difficulties using the Client software due to firewall limitations. ▪ Other users experienced problems when loading the Client software. ▪ Some users were not able to view the jpegs snippet parts of reports. ▪ Users were not provided with a username and password during the training sessions.	This issue was eventually remedied within Exelon, and/or users were able to install and use the Client software on personal computers at their homes. These problems involved individual systems rather than the entire team and were handled on an individual basis. This issue was remedied by having the users change settings within MS Word to allow the images to be shown.
Comment Delineation and Response: Test comments were received from Exelon and assigned to a responder as part of the delineation process. It was unclear how the eComment Administrator would interface with Exelon before a document is delineated.	Exelon identified a point of contact (POC) for comment delineation. The eComment Administrator worked with the POC to determine the best responder for each comment.
Administration's Role: The eComment administrators' role in the trial run was to delineate comments and update the eComment system during the trial run (i.e., ensure that the initial responses were moved up the chain correctly). Some of the challenges were as follows: Some users responded directly to the eComment email address rather than the administrator's addresses. On one occasion, a comment that should have bypassed CH2MHILL's review was not manually sent to the next responder.	This was remedied by reviewing comment status and consulting the review matrix. Further, the eComment Administrator must communicate with Exelon when assigning a responder to each comment. Lastly, it is important that the individual uses be instructed to respond to the eComment administrator. Finally, provide technical assistance for users that encounter problems with the system.
eComment test run identified several problems.	Trial run was appropriate; The glitches that were found in the system during the trial run were addressed rather than during the actual RAI process All users were able to access the Client software or the ftp site allowing comments to be received, delineated, and tracked throughout the review process.

Table 4: Lessons Learned

Issue	Lessons Learned / Recommendation
Background: Rev. 1 of the ESPA reported two different values for Maximum Wet Bulb Temperature (77.2 degrees vs. 78 degrees F). The Rev. 1 submittal information was incorrect (Corrective action report (CAR) 06F0046). Two values were obtained from the published climatological records for Peoria and Springfield of 77 degrees and 78 degrees F. The ESPA originally stated 78 degrees F because it was more conservative. Because of follow-up questions raised in connection with one of the RAIs, contractor subsequently obtained the detailed hourly surface observations for both stations and did any analysis of the 1% exceedances values for the period of record and found the more precise number to be 77.2 degrees F.	NRC believed the 78 degrees F value to be the correct number from the referenced CD data (NRDC 2000). Therefore, the text was revised in Rev. 2 of the ESPA to reflect NRC's preferred value of 78 degrees F (thought to be more conservative).
Omission of figures/data table pages from Rev. 0 to Rev. 1 (i.e., Rev. 1 submittal was missing information). Specifically: SSAR, Appendix B, Plate 1 Seismic Hazards Report for EGC ESP Site Structure Features; SSAR, Appendix B, eight missing data sheets; Figure 3.2-1 – Ultimate Heat Sink Schematic. Corrective action report (CAR) 06F0047.	When Rev. 0 of the ESPA was originally completed, the Word files were converted to PDF and provided to Exelon for review and finalization. Some changes were subsequently made to the PDF files by the client prior to submittal to NRC; however, the Word files were not changed. CH2M HILL received the final version of Rev. 0 on CD. When it came time to prepare Rev. 1 of the application, a comparison was made of the Original Rev. 0 Word files to the final PDFs in order to update the Word files so both versions matched. Working with the multitude of Word and PDF files resulted in a few pages being inadvertently omitted from Rev. 1 of the COLA submitted to the client.
RAI Response SOI1-14 (12/21/05) Associated Application Revision (SSAR, Chapter 2, Section 2.4.7, third paragraph) stated "At the minimum lake level of 277 ft msl. This should have been "677 ft msl"…The information provided by the author was inaccurate, (Corrective Action Report (CAR) 06F0048). This was a typographical error made by the author.	The text was revised in Rev. 2 of the ESPA to resolve this issue.
Rev. 2 ESPA Table 1.4.1, item 3.1.10 "reverted" back to Rev. 1 value of 1065 AFDD vs. 1141.5 AFDD, Corrective Action Report (CAR) 06F0049. This was a typographical error.	The text was revised in Rev. 2 of the ESPA to correct this error. Following issuance of Rev. 2, a comparison was made of Word files against PDF files; changes were subsequently made to the Rev. 2 Word Files to match the Rev. 2 PDF version.

APPENDIX B. *Grand Gulf*, *Early Site Permit Demonstration Project Lessons Learned*, Entergy Nuclear, Inc., August 23, 2007

Entergy

Entergy Nuclear, Inc.
1340 Echelon Parkway
Jackson, Mississippi 39213

July 31, 2007

U. S. Department of Energy
Office of Nuclear Energy
1955 Fremont Avenue
Idaho Falls, ID 83415

Subject: Final Grand Gulf ESP Lessons Learned

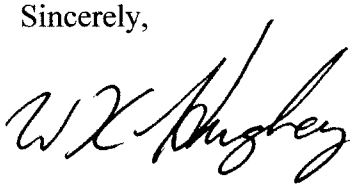
Reference: Award Number DE-FC07-021D14413 ESP Demonstration Project

CEXO- 2007-00266

Dear Sirs:

Entergy Nuclear Potomac Company is submitting the Grand Gulf Early Site Permit Lessons Learned in accordance with Task 4 of DE-FC07-021D14413 Amendment A000 Part 111. The final report to DOE summarizing results of resource requirements including cost and schedule information will be submitted by October 1, 2007.

Sincerely,



W. Kenneth Hughey
Sr. Manager, Business Development

WKH/MB/bt
attachments
cc: Mike Bourgeois
Jerry Burford
Paul Hinnenkamp
Tom Miller
Tom Williamson
George Zinke
Corporate File [13]

Disclaimer

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Entergy Nuclear, Inc.
Early Site Permit Demonstration Project
Lessons Learned

June 29, 2007

This report describes lessons learned (LL) during execution of the Entergy Nuclear Grand Gulf Nuclear Station (GG) Early Site Permit (ESP) program. This report provides the LL content specified as a deliverable under DOE Contract No. DE-PS07-021D14305.

While the LL presented in this report address the logistics of preparation and NRC review of an ESP application, the final lessons to be learned from the ESP demonstration must be defined against the overall long-term objective of developing an operating nuclear power plant. Additional lessons learned and perspectives on the LL reported herein will become apparent as:

- An ESP is issued and specific terms can be analyzed,
- An ESP is used in a Combined Construction and Operating License (COL) proceeding that leads to licensing and operation of a new nuclear power plant, and
- Final regulations and related guidance are issued that clarify the finality of an ESP as originally envisioned in the demonstration project.

Several key questions that define critical issues regarding the effectiveness of Part 52 process as a whole have been identified during the ESP project. Answers to these questions will form the framework for some of the most important future lessons to be learned from the ESP demonstration.

- Will NRC's findings in the ESP address the full spectrum of site issues anticipated?
- To what degree will safety and environmental issues, resolved in the ESP, be re-opened by during the Combined Construction and Operating License Application (COLA) proceedings?
- What will be the standards for re-opening safety or environmental ESP findings in a COL proceeding given the potential for changes in site conditions over time?
- Will an ESP prove to provide demonstrable value in early resolution of site issues and associated reduction of schedule and uncertainty at COL?
- Will the PPE approach provide applicants with sufficient flexibility for design selection at COL? Does the Part 52 process provide for true de-coupling of site and design?
- Does the ESP component of the Part 52 process contribute to predictability in nuclear power plants to be licensing?

The following LL were identified through project reviews and interviews with involved management and technical staff from both applicant and contractor organizations. In addition to the application preparation and review processes, perspectives on these LLs was also derived from participation in industry working groups (e.g., the Nuclear Energy Institute (NEI) ESP Task Force).

1. An overarching LL is that the ESP appears to have value for applicants as a site banking and risk mitigation strategy, especially for greenfield sites.[1] It allows surfacing and, in some cases,

[1] ESP value, in terms of banking and risk mitigation appears to be most effective for the safety review portion of the ESP. It may be less effective for environmental aspects and emergency planning.

resolution of site-related issues before major capital expenditures are made. This is especially important in the Part 52 process, where larger sums must be spent earlier in the plant development process. Thus, an ESP allows applicants to proceed with less money at risk. Risk mitigation available through an ESP applies both to licensing delays and uncertainties (knowledge gap).

2. In order to complete an ESP application that allows flexibility for future selection of a plant design, a set of hypothetical plant parameters must be derived which form the basis for analyses in the ESP. In order for a design to be viable as a future option under an ESP, Design Certification (DC) holders and potential future vendors must supply and stand behind parameter values for their designs.

   The Plant Parameter Envelope (PPE) approach adopted in the GG ESP application was not initially understood by some NRC staff, and the relationship of this concept to existing regulations and guidance was not clear (e.g., Part 52, Part 100). Specific areas of clarification that required agreement between the applicant and NRC included:

   - Use of bounding analyses for environmental impacts (i.e., qualifying the site for a specified level of impact vs. the impact of a specific plant design), and
   - Need under NRC regulations to provide specific radiological consequence analyses.

   From an environmental impact perspective, the PPE may force issues to be deferred to COL, because additional site-specific design information (e.g., intake and discharge structure, storm water system, construction plans and techniques) is necessary to fully quantify some impacts.

   The PPE approach has led to identification of uncertainty in what level of design detail is required for the COLA Environmental Report (ER). This is because of apparent Staff interpretations of NUREG-1555 (the Environmental Standard Review Plan (ESRP)) and Staff expectations that additional design detail would be available and provided in a COLA. However, in fact, the Part 52 process may not call for that ESRP level of detail to be available at COLA, but rather could be a business decision as to when the applicant chooses to procure final design engineering. This issue is currently open with the NRC.[2]

   Considerable interaction between industry and the NRC staff was necessary to develop common expectations and understandings on the PPE approach. These interactions appear to have been successful in defining a basis for the NRC review and issuance of an ESP under the PPE approach. However, in general, modifications to NRC regulations and guidance to explicitly recognize such an approach for future applicants have not been implemented.[3]

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[2] While outside the scope of this analysis of ESP LL, it is possible that issues related to level of design detail required for COLA may also apply to COLAs not referencing an ESP. This is the case because COLA projects with no ESP face the same business decision as to when the final engineering design would be done to meet the ESRP guidance. While the ESRP is a relatively recent document, it generally fails to recognize that certain design details would not likely be available at ESP or even at COLA.

[3] It is possible that the Staff's new COLA guidance may recognize, to some degree, the PPE approach. However, the Part 52 rulemaking, except for minor mention in Staff response to industry comments, is silent on the PPE approach. (See the final Part 52 rulemaking and Statements of Consideration in SECY-06-0220.) The Staff considered the rule to be adequate without specific mention of the use of PPE. This will be tested via the development of the first COLAs referencing ESPs.

3. Neither regulatory nor industry guidance for ESPs were found to adequately reflect applicant needs for ESP application program planning and execution with regard to:
    a. Incorporating the PPE approach (see LL 2, above),
    b. Addressing existing, versus greenfield, sites (e.g., use of data from licensing the existing plant (item e below); application content and schedule),
    c. Developing an ESP for a merchant plant versus an ESP for a site to be developed by a regulated utility,
    d. Executing site selection processes for merchant plants (i.e., where the Region of Interest is not a regulated utility's service territory),
    e. Using existing information from operating nuclear plant sites (including both original licensing data for operating plants and data collected in operational monitoring programs) to support the ESP application (versus current guidance that reflects an assumption that all site information is unknown),
    f. Addressing transmission issues for a merchant plant, where the plant developer will not be responsible for providing transmission access, and,
    g. Addressing a broad spectrum of possible (e.g., non-light-water reactor) designs in the application.

    Approaches for addressing these issues in the GG ESP application were developed through NEI coordinated pre-application discussions with NRC staff and in the application review and Request for Additional Information (RAI) process. Gaps in NRC guidance and clarification should be sought by applicants early in the ESP planning process. NOTE: This was effected via the NEI ESP Task Force for generic issues in cooperation with the pilot applicants; site- and applicant-specific issues should be subject to the same process, as applicable for individual sites and applicant business plans.

    Specific modifications have not been made to either industry[4] or NRC guidance to address these issues for future ESP applicants.

4. Applicants planning to develop a merchant plant must take into account special institutional and interface issues when preparing an ESP application for an existing regulated plant site. Business, organizational, and cultural aspects of planning, managing, and executing ESP work must be taken into account. Issues include:
    a. Affect of ESP application preparation activities on plant operations and on ongoing institutional and public relations programs.
    b. Interface between the operations requirements for the existing plant operator and the ESP applicant organization (e.g., site access and security, affect of ESP findings (see LLs 8 & 12) on operating plant licensing basis).
    c. Coordination of on-site data collection activities by ESP subcontractors (who may not be familiar with nuclear site access, security, and data protection requirements).

[4] It should be noted that per agreements with the NRC Staff, NEI discontinued work on the industry's ESP related guidance (NEI 01-02). While the ESP Task Force developed positions and resolutions, including formal NRC response, results of these liaisons were not compiled into a single record. As a practical matter, these results are informative as an information source but carry little licensing weight. Regarding NEI 01-02, by NRC-NEI agreement this industry guidance was left in draft form and never issued by NEI nor endorsed by the NRC.

d. Regulatory requirements placed on plant operators (e.g., prohibition against giving an unregulated affiliate a preferred position in use of potential site locations at an existing regulated site).

For the GG ESP application, these issues were addressed on a case-by-case basis as they were identified. Other than being aware that such issues must be addressed during ESP project execution, no generally applicable future corrective actions are identified for this LL.

5. During data collection and analysis for the GG ESP, it was determined that natural ecological succession had occurred on undeveloped portions of the existing site; in some cases this resulted in conditions (e.g., sensitive ecological areas, wetlands) that differed significantly from those extant when the original plant license was issued. These conditions were taken into account in the GG ESP application in the appropriate site description sections of the ESP Environmental Report (ESP ER). However, future ESP applicants should take into account the fact that such conditions may require additional analysis when an ESP is developed for a site with an existing unit(s).

6. As noted in LL 2, existing guidance on Quality Assurance (QA) requirements was not adequate to provide a basis for establishing formal QA programs for ESP application data collection and analysis. Data sets for which this issue was a concern in the GG ESP were:
   a. Data available from original licensing documents and operational programs at the existing plant site (e.g., seismic, meteorology, water quantity and quality, calculations and analyses to support the licensing bases by vendors and AE and the Utility),
   b. Data from industry sources (e.g., EPRI seismic data and analyses),
   c. Information used to support ESP findings on safety-related issues,
   d. Data provided by the regulators (including NRC), and
   e. Plant design data from vendors, especially information regarding non-certified designs used in developing the PPE.

   As a practical matter, the QA approach for the GG ESP application was developed through the NEI ESP task force and direct interactions with NRC. Resolution of ESP QA issues was still in progress at the time of this writing (early 2007). A draft final rule and supporting Standard Review Plans (SRP) and regulatory guide (Reg. Guide 1.206) were scheduled to be publicly available (electronically) by March 2007.

   Because QA programs must be in place prior to data collection or analysis, future ESP applicants will need to ensure that there is a clear understanding of QA requirements for each data set being developed as part of the ESP application. In particular, any ESP information used in making NRC findings that will bear on safety-related issues (e.g., seismic characterization of the site) must be conducted under a QA program compliant with requirements of 10 CFR 50, Appendix B.

7. For future applicants preparing ESP applications prior to selection of a reactor technology, processes for development of PPE data for each of the candidate designs being considered must be improved over that available to the pilot ESP applicants; both the logistics of obtaining data

from vendors and the quality and consistency of data obtained should be addressed. Specific issues encountered in preparing the PPE used in the GG ESP application were:

a. PPE information was not readily forthcoming from vendors and some vendors did not appear to assign a high priority to providing PPE data. A unified industry approach to emphasize the importance of PPE information in future ESP applications may be necessary.
b. Some PPE data were difficult to define for reactor designs that were still in the conceptual stage of development; vendors for these designs appeared to use the "standard" value (e.g., value from the URD) for a parameter rather than a value specific to that design. This will likely confuse the issue of evaluation of site parameters and bounding of impact at the COL stage.
c. PPE definitions should be provided to vendors with the initial data request. Actual data should not be provided as examples, to ensure that vendors consciously develop information for their design, versus simply endorsing the data provided.
d. Development of data not specific to a reactor design or reactor vendor should be considered, so that the data are standard in ESP applications (e.g., diesel generator or gas turbine exhaust emissions).
e. Individual vendor data did not always exhibit internal quality or consistency. The pilot applicants identified a number of errors and inconsistencies in PPE data provided by vendors.
f. The quality pedigree of PPE data developed by vendors could not be documented or verified. Data from vendors must be viewed critically by applicants to ensure a satisfactory quality documentation and internal consistency. In this context, it must be remembered that accuracy and defensibility of data in an ESP application is the applicant's responsibility.
g. While the general use of the PPE approach was similar for each of the pilot ESP projects, the final presentation of PPE values in the ESP SSAR and ER were not consistent among the pilots. For GG, design parameters "used" in safety analyses were distinguished from those "used" in the environmental review. Further, the GG ESP project held the position that site characteristics were established in the safety review and should not be listed in the ESP ER. This GG approach, in that it differed from other ESP applications, led to a more complicated GG Atomic Safety and Licensing Board (ASLB) proceeding due to Licensing Board confusion and questions. After extended testimony (written and oral), the issues were fully resolved. The final value of any approach cannot be fully determined until permits are issued, analyzed, and used successfully in a COLA.

8. The scope of questions received at public meetings conducted as part of the ESP process applications went beyond the stated scope of the meeting (i.e., ESP application). Both NRC and applicant management should be on hand to effectively answer both broad policy questions as well as questions on the ESP itself.

9. Compliance with investigative and analytical requirements of the current NRC seismic regulations and guidance (Regulatory Guide 1.165 methodology) were found to present significant challenges in defining seismic design bases for new plants. Specific issues encountered in preparing the GG ESP application include:

a. Results derived using the new probabilistic methodology do not correlate well with deterministic design bases used for the existing plant fleet. Depending on site location, new design bases can appear to be more demanding than the licensing basis for operating plants. Because existing plants are grandfathered under the regulations, this is not a regulatory issue, but it could be alleged to be a problem in the sense that existing plant design could be viewed to be inadequate. The associated "public relations" problem for operating plants could be a deterrent for potential ESP applicants.
b. Regulatory Guide 1.165 specifies a "reference probability" for defining the safe shutdown earthquake ground motion that is based on a probabilistic seismic hazard analysis (PSHA) using information and methodology from the late 1980s and early 1990s. This information and methodology has been significantly revised. A new reference probability for defining the site seismic hazards should be defined using an updated Electric Power Research Institute (EPRI) PSHA. The mean probability should be used in hazard determinations because the median is too sensitive to extreme values with high uncertainty.
c. Site response analysis, even at existing plant sites, requires site-specific investigations to develop input parameters. Previous investigations (e.g., in the 1970s) conducted to support licensing of existing plants will not likely be adequate, because of the new probabilistic regulatory requirements and the need for location-specific soil conditions at the new plant footprint.
d. EPRI PSHAs for comparison with site-specific results (in accordance with Regulatory Guide 1.165) are not available for all sites; adequate schedule time and resources to accomplish the EPRI analysis must be factored into the ESP program plan.
e. The original EPRI PSHA methodology and results should be updated to reflect current knowledge and methodology. The original EPRI ground motion attenuation model was updated in 2004. The seismic source model should similarly be updated for the CEUS. If not, future ESP and COL applicants should be allowed to "build upon" the updated seismic source information submitted by previous applicants and approved by NRC staff, without having to re-document the updated seismic source information.
f. Current regulatory guidance (Regulatory Guide 1.165) specifies a "hazard-based" approach for developing the SSE. Regulatory guidance should be modified so that applicants can use a "performance-based" approach for developing the SSE.
g. Additional regulatory guidance is needed on what constitutes a "significant" increase when comparing site-specific results with EPRI and/or LLNL results, in accordance with the sensitivity analysis provisions of Regulatory Guide 1.165.
h. Record-keeping and archiving of records (including quality assurance requirements and records) from previous site investigations at existing sites are not always adequate for use in a current ESP application.
i. A high level of interaction between industry organizations (e.g., EPRI, NEI) and the applicant is necessary to ensure full understanding of the methods, assumptions, and results of the seismic analysis and the practical realities of following the regulatory guidance for each ESP site.

For the GG ESP, these issues were addressed by a combination of site-specific techniques and technically supported variations from regulatory guidance. Many of the generic issues identified in this LL are being addressed through industry/NRC initiatives; these include:

- Revision and update of the EPRI CEUS PHSA,
- Vendor modifications to seismic qualifications for certified designs,
- NEI seismic task force working with NRC to appropriately modify seismic regulatory guidance,
- Development of new regulatory guidance (Regulatory Guide 1.208) to accept a performance-based approach for developing the SSE, and,
- NEI/EPRI sponsored development of methodology to better characterize high frequency ground motion.

10. Overall, the Atomic Safety and Licensing Board (ASLB) hearing process (in the context of Part 52) is not yet well defined. In the application review process, each of the pilot ESP projects resolved any contentions such that the only remaining Board action required for permit issuance was the mandatory hearing. While Boards formally sought and received Commission guidance on the scope of the mandatory hearing, in practice each Licensing Board requested different schedules, information, and approaches in the conduct of the individual hearings. The GG ESP hearing focused to a much greater degree than expected on how ESP findings would be used in future COL proceedings. The Board's interests were on how ESP findings would be used in the future and under what circumstances (e.g., changes in site conditions) ESP findings would be re-opened in future proceedings. More formal guidance (either through regulations, policy and/or through feedback from future COL processes) will be required to establish for future ESP applicants and the NRC staff a common set of expectations for the ESP ASLB hearings.

    A separate industry initiative is focused on working with NRC Staff to facilitate a rulemaking that could eliminate with the mandatory hearing portion of the ESP process. Thus, if there is no contested issue, the permit decision could go to the Commission earlier, thus shortening the ESP schedule by several months. Work continues on this legal process improvement.

The overall GG ESP strategy was to use data and licensing basis information from the existing plant as much as possible in preparing the ESP application. Two LL emerged from implementation of this strategy:

11. Use of existing plant data avoided the need for a full 24-month pre-application data collection period-of-record. Inherent in use of existing plant data is that the applicant must demonstrate that the data is characteristic of the new plant configuration (e.g., footprint, intake and discharge locations). Existing plant data proved to provide real value in preparing an ESP for the site; some QA issues arose in adopting the data, but these were resolved in the process of application preparation (see LL 6).

12. NRC review of the GG ESP in some cases went into the basis for existing plant license conditions and requirements, versus the applicant expectation that the existing licensing basis would be taken as an approved construct. Issues for which this applied included emergency planning, transport analysis of liquid radwaste tank accidental spills, and characterization and analysis of explosion hazards. This new review/analysis essentially constituted a potential challenge to the existing GG licensing basis. Although the new review had the potential for affecting virtually any aspect of GG licensing referenced in the ESP application, in practice only

a few issues in the GG licensing basis were actually affected. This resulted in a new review of the original plant licensing basis in some cases.

13. The handling of emergency planning (EP) issues in an ESP proceeding remains an unresolved issue. Neither the Full & Complete Plan option nor the NRC Major Features Plan review intentions was fully understood by applicants. Based on experience with the GG ESP, there now appears to be a preference now toward using the Full & Complete Plan approach with future specified actions (or ITAAC at the COL phase). It is expected that experience with a full Part 52 process (i.e., ESP followed by a COL) will be required before the EP issue is fully resolved. For an ESP at an existing plant site, EP issues arising can include review of the existing site plan; for example, new evacuation time estimates may be required if changed conditions are identified in the ESP application data gathering process.

14. NRC interfaces with the public and other agencies resulted in communications without the knowledge of the applicant that, in some cases, had the effect of mis-communicating the applicant's intentions with regard to the GG ESP project. This issue arose not only at the GG site but at alternative sites visited by the NRC reviewers. Communications consistency was also affected by differences in who was contacted by NRC safety and environmental reviewers. (NOTE: This problem could be addressed to some extent by the NRC's agreeing to appoint a single project manager (PM) for the docket, versus having separate safety and environmental PMs. This is under consideration by NRC Management.)

15. The GG ESP application successfully addressed alternatives under a merchant plant scenario (e.g., alternative sources of power and alternate site considerations). While the NRC environmental review guidance (ESRP) recognizes the changing electrical generation market, it still poses questions and seeks information that is not consistent with deregulated and/or merchant plant scenarios. However, alternate energy source evaluations and alternate site considerations were successfully resolved at the ESP stage. Deregulation and separation of generation and transmission service providers can preclude a meaningful review of transmission line and right-of-way (ROW) impacts at the ESP stage due to uncertainty in transmission line changes during the life of the permit. For this reason, review of ROW impacts for any new lines or modifications, if required, could not be addressed at ESP and were deferred to COL.

16. During the GG ESP project, inconsistencies were identified in terminology used in vendor design certifications (DC) versus those being used in ESP applications. These distinctions in terminology will have to be resolved at a detailed level in future COL applications, where it will be necessary to demonstrate that ESP site characteristics are consistent with DC plant parameters. Future use of a consistent set of detailed terms for site-related parameters in all components of the Part 52 process will facilitate both application preparation and regulatory review.

Several additional lessons learned became apparent once the Early Site Permit had been issued, as follows:

1. The ESP applicant should define in its application the ESP COL Action[5] items required to address any issues or items that will require further closure or analysis in the COL application FSAR. This would provide the applicant more control over wording and ensure more clarity in what would be needed and appropriate at the COL stage, rather than allowing the NRC to define them in the ESP SER. (It is assumed, here, that the Commission will reference the ESP's final version of ESP COL Action items and reference them in the approved Permit.)

2. A definition needs to be provided by NRC staff for a set of "bounding parameters" which were introduced into the ESP SSAR FSER without adequate discussion or explanation as to what these parameters mean. Appendix A.4 in the FSER provides some explanation but is neither sufficient nor clear. This lack of clarity was also raised by the Licensing Board during the GG ESP mandatory hearing. Further, even if these parameters were to change substantially, they would have little or no impact on the SSAR, its conclusions, or site suitability. Future ESP applications should discuss this concept with the Staff to better identify and address the Staff's purpose in defining this set of "bounding plant parameters" (which were subsequently defined by the Commission in the approved ESP as permit conditions). On the surface, these do not warrant the level of permit conditions, subject to the variance process.

3. For the most part, site characteristics are developed per regulations and guidance as part of the safety review, in accordance with NUREG-0800 and Division 1 regulatory guides. As such, the majority of site characteristics that are primarily relevant to the safety reviews. There are relatively few site characteristics are established for and used in the ESP ER (e.g., the 50% X/Q used in dose calculations in ER analyses vs. the 95% confidence level X/Q values used in safety reviews). ESP applicants should be careful to avoid separate listings of site characteristics for the SSAR and ER. The primary listing, based on the ESP safety review and on future use in a COL, should be the SSAR listing. The ER listing of site characteristics should be narrowly focused on those site characteristics unique to the environmental review. If site characteristics developed in the SSAR are required for ER analyses, the ER should reference the SSAR. These steps are suggested to insure the NRC Staff and ASLB have a clearer understanding of the application treatment of site characteristics and to support a clearer record for use of these characteristics in a subsequent COL application referencing the ESP.

4. PPEs should be document specific; i.e., the parameters relevant to and used in the ER evaluations should be included in the ER PPE tables, and those relevant to and used in the SAR analyses in the SAR PPE tables. A rigorous review should be done to make sure the parameters listed in the respective tables are actually "used" in the analyses and evaluations done in the ER and SAR. These steps will help to develop a more concise listing of PPE parameters that must be considered in the COL demonstration that the final facility (actual) design characteristics fall within the PPE design parameters established at ESP. A concise listing avoids the need to demonstrate little or no impact at COL for parameters not used in the SSAR or ER (and thus, proportionally reduces the resources required to develop this COLA ER demonstration).

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[5] Reactor vendor design certification applications (i.e., "DCD") identify issues that are most appropriately addressed in the COL application (that references the DCD). These are identified as COL information items. Unlike the DCD, the ESP application did not identify similar items (that would be addressed at the COL stage). The NRC Staff, therefore, collected and identified those issues as "ESP COL Action Items" in the body of the FSER. This LL suggests that the ESP application should define those actions to have better control on wording, scope, etc.

Secondly, with a greater number of PPE parameters, there is more chance that a variance might occur. If the PPE parameter involves a variance but is of little importance and not used in the SSAR or ER, resources devoted to supporting (evaluation, justification and documentation) the variance would be poorly utilized.

5. Parameters with "low impact" should not be individually listed in the PPE tables; for example, raw water requirements for the fire protection makeup, demineralizer system makeup or the potable water system could be combined into a bounding water requirement so demonstration at COL that the selected technology design parameter "falls within" the ESP design parameter can be more readily made. (In this case, for example, the demonstration would be based on the overall water requirement, not each individual component.) Note that these individual inputs could and/or should be discussed in the text of the document (ER or SAR), but would not be formally listed in the PPE table.

6. The newly identified set of parameters called "controlling values of parameters" in the ESP, also known as "bounding parameters" in the NRC FSER, NUREG-1840, are not well defined as to their meaning and importance to the ESP and to the COLA. Regulations require the COL applicant to demonstrate that the design of the facility falls within the site characteristics and design parameters specified in the early site permit (10 CFR 51.50(c)). These parameters are identified separately from the Site Characteristics in Appendix A of the ESP, and the PPE Parameters in Appendix D of the ESP. Additional guidance is required from NRC to define the regulatory role of these parameters in regards to both the ESP conditions and any COL action items.

7. The industry PPE source document (template) used by the applicants for ESP needs to be updated, scrubbed, revised appropriately to address parameters that are not well defined (e.g., miscellaneous discharges to surface water bodies – PPE Section 8). Also, notations should be provided for certain parameters that – though included in the table – should not be subject to the "falls within" demonstration at COL; examples include construction population, operations work force, and construction noise. All these items are required for ESP evaluations for one or more reasons, and should be included in the text of the appropriate document (e.g., ER), but they should not be characterized as "PPE Parameters" that then are compared to that of a selected reactor design in the COL application.

8. In the industry PPE source document, some guidance as to reporting of parameters as "unit specific" or for the "total plant" (i.e., for the site) would be appropriate – when to use one or the other, and why. A PPE based ESP may consider more than one unit or group of units (a unit being a group, if the reactor is modular in design and the electrical output is small such that a group is required to achieve an overall MWe output, for comparative purposes) where a number of "units" are required to achieve the generation goal for the site. Therefore, site suitability may require a multiple of certain PPE parameters to assess overall impacts. For example, makeup water for a 1000 MWe "unit" would be doubled if the goal for the site is 2000 MWe.

9. Consideration should be given to adding certain additional, key environmental parameters to the PPE list for the ER that are not currently included. Land use for a particular reactor design, per unit, or per module, for a twin or single unit, etc. is an example since land use and footprint are

important issues in site evaluation. Vendors should be requested to provide the land use requirements for both a single unit and a twin or multiple units, because it may not be appropriate to simply double required areas for the second of a twin unit design.

10. PPE parameters should be assigned a "direction" regarding how they are limiting for the site suitability assessment; that is, is the number a maximum, such that anything less is better, or is it minimum and more is better. This then will assist in determination of whether the ESP parameter bounds the reactor design characteristic at COL.

APPENDIX C. *North Anna Early Site Permit Project Summary Report*, Dominion Nuclear North Anna, LLC, February 2008

North Anna
Early Site Permit Project
Summary Report

U.S. Department of Energy
Cooperative Agreement DE-FC07-02ID14411

Prepared by:

Dominion Nuclear North Anna, LLC

February 2008

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1. Introduction

This report provides a summary of the North Anna Early Site Permit (ESP) Project. The North Anna ESP Project was carried out by Dominion Nuclear North Anna, LLC (Dominion) with the following objectives:

- Prepare and submit an ESP application to the NRC for Dominion's North Anna site located in Virginia
- Support the NRC review process and mandatory hearing
- Receive the ESP when issued by the NRC

The project cost was shared evenly between Dominion and the U. S. Department of Energy (DOE) under DOE's NP-2010 Program via Cooperative Agreement DE-FC07-02ID14411.

Section 2 of this report provides a brief project summary. Section 3 identifies lessons learned from the project. In particular, opportunities to enhance the regulatory process for future ESPs and Combined Licenses (COLs) are identified. Section 4 describes the chronology of documents developed both by the nuclear industry and the NRC to provide guidance for preparing and reviewing ESP applications. Based on the North Anna experience, Section 5 provides a description of the activities necessary to prepare an ESP application and support the NRC review and hearing.

Tables and figures are located at the end of the report.

2. Project Summary

The following is a summary of the North Anna ESP Project. Details of project progress and issues faced are identified in the quarterly and annual progress submitted to DOE for Cooperative Agreement DE-FC07-02ID14411.

2.1 Project Schedule

Major milestones included:

- The project began on July 1, 2002.
- Revision 0 of the ESP Application was submitted to the NRC on September 25, 2003.
- The ESP application was revised nine times, mainly to incorporate responses to NRC questions, with the final revision, Revision 9, submitted on September 12, 2006.
- Dominion notified the NRC of a change in cooling water approach on October 24, 2005 which resulted in a significant delay in the NRC review schedule.
- The Final Safety Evaluation Report and Final Environmental Impact Statement were issued in November and December 2006, respectively.
- The initial decision of the Atomic Safety and Licensing Board was issued on June 29, 2007.
- The Commission decision was issued on November 20, 2007.
- The ESP was issued on November 27, 2007.

Table 1 identifies schedule milestones for the project.

2.2 Project Team

Dominion led the project. Bechtel Power Corporation (Bechtel) served as the primary contractor to prepare the ESP application. Specialty contractors supporting Dominion and Bechtel included Tetra Tech NUS, Inc. (environmental data collection and analysis, environmental impact assessments), William Lettis and Associates (geologic field investigations and seismic source characterization), Mactec Engineering and Consulting, Inc. (site subsurface investigation and laboratory testing), and Risk Engineering, Inc. (probabilistic seismic hazard analyses).

2.3 NRC Review Process

Dominion responded to approximately 250 requests for additional information (RAIs) issued by the NRC. An additional approximately 250 questions were issued by the NRC Atomic Safety and Licensing Board (ASLB) panel to support the mandatory hearing.

2.4 Interactions With Agencies and Organizations

Recognizing that applying for an ESP is a federal licensing action before the NRC, it is also an action that is conducted by the applicant and regulator in the public eye, that is, there are several deliberate opportunities coordinated by the NRC Staff during their review for the public to provide input and comment. In addition to NRC regulations and guidance followed directly in the ESP process, there are also other federal, state, and local regulatory authorities interacting with the NRC's review. Such interactions may be as simple as consultation or solicitation of comments, or may be as involved as obtaining certifications and permits for actions to be conducted at the site and correlated with NRC's approvals. The National Environmental Policy Act, or NEPA, is an example of a federal statute requiring an environmental review by the NRC, in parallel with the NRC's technical review under 10 CFR 51, which necessitates interactions with multiple federal and state agencies. Examples of agencies and organizations with whom Dominion interacted during the ESP project included the U.S. Fish & Wildlife Service, U.S. Army Corps of Engineers, Federal Aviation Administration, Virginia Department of Environmental Quality, Virginia Department of Historic Resources, local counties' Boards of Supervisors, and local community, business, and citizen action groups. Considerable information on these interactions during the North Anna ESP Project is provided in the ESP application and NRC review documents.

3. Lessons Learned

Lessons learned were collected during each phase of the project—preparation of the ESP application, the NRC safety and environmental review, and the ASLB hearing. The lessons learned were collected by the project team, including Dominion, Bechtel, and other contractor personnel by project managers, licensing engineers, authors, schedulers, document production staff, and others.

Table 2 identifies opportunities to enhance the regulatory process for ESPs and COLs based on lessons learned from the North Anna ESP Project. Lessons learned associated with project execution activities are listed in Table 3 and are sorted into several categories including project management, author and licensing personnel, and document production. In addition, Table 3 lists lessons learned presented by Dominion to the ACRS Subcommittee on Early Site Permits in September 2006 and ESP lessons learned as described in ACRS Correspondence in November 2007.

Certain lessons learned captured by the ESP project team have been overcome by events. For example, the issuance of Regulatory Guide 1.206 has since resolved many of the issues faced at the ESP stage regarding application content and interpretation of regulatory guidance. The lessons learned collected by the ESP project team and reported herein have not been screened for those lessons that may have been addressed by updated regulatory guidance. Rather, the lessons learned are captured to document the actual project experience.

Table 3 also identifies those lessons learned from the ESP stage that have been incorporated into Dominion's efforts on the North Anna COL Project (via DOE Cooperative Agreement DE-FC07-05ID14635). These include:

- First, substantial time was included in the COL schedule to allow for project reviews as well as an extended period of time at the end of the schedule for "page turn" reviews. This page turn process for the COLA was performed over a four week period and was viewed to be an important element of the COLA project effort.

- Second, the Author Presentation process (using a "Basis Document" format) was employed to confirm author acceptance, ensure review team agreement with the author's approach, and estab-

lish the specific section strategy prior to large-scale investment of time and effort. This process was used for all COLA sections.

- Third, a fully integrated, logic-driven baseline schedule for the COLA preparation effort was developed. The project team aggressively updated the logic (weekly in some cases) to reflect developments as the work proceeded.

3.1 Lessons Learned for Project Management Personnel

Part 1 of Table 3 lists lessons learned that may be important to future ESP (or COL) project management personnel. Several lessons learned are considered to be best practices for future ESP and COL projects. These best practices fall into the general category of up-front planning. Author presentations were found to be an excellent method for establishing section strategies before significant efforts were expended resulting in re-direction and/or rework. Pre-job briefings on individual work activities (e.g., prior to the start of a complicated analysis) were used to discuss the effort and resolve issues before work began.

Another key lesson learned pointed out the importance of holding frequent coordination meetings to ensure good communication among all project participants, particularly when multiple ESP sections addressed common issues.

Of note is a lesson learned that highlights the need to provide extensive training to the team to emphasize the quality of the work. The North Anna ESP Project was a first-of-a-kind effort and many project participants did not have experience with the rigor required to prepare a document of this type and complexity. Quality of the work must be continually emphasized to all project participants regardless of their prior experience.

Another dominant theme in several of the lessons learned is that the project activities must be scheduled, and systematic progress must be made to avoid the "bow wave" of section preparation and review at the end of the effort. Also, author presentations should be shown as a scheduled project milestone for each section of the application.

3.2 Lessons Learned for Author and Licensing Personnel

Part 2 of Table 3 lists lessons learned that may be important to future ESP (or COL) author and licensing personnel.

The North Anna ESP application was prepared before the issuance of Regulatory Guide 1.206 and supporting regulatory guidance; thus, the project encountered numerous issues regarding basic licensing principles, e.g., what information must be submitted to satisfy the regulations and the NRC Staff's review. Certain important lessons learned were identified. For example, licensing personnel should plan to have "page turn" reviews of the entire document prior to submittal. These reviews were found to be most effective in ensuring consistency among related sections, consistency of terminology, etc. A minimum of two to three weeks duration should be allowed for the "page turn" reviews.

3.3 Lessons Learned for Document Production Personnel

Part 3 of Table 3 lists lessons learned that were captured over the course of the work that may be important to future ESP (or COL) document production personnel. Lessons learned in this area included technical editing considerations, preparation of a Writer's Guide, and electronic formatting.

3.4 Lessons Learned Presented by Dominion to the ACRS Subcommittee on Early Site Permits, September 6, 2006

Part 4 of Table 3 presents a summary of the presentation material used by Dominion in a September 6, 2006, presentation to the ACRS Subcommittee on Early Site Permits. The presentation included a listing of lessons learned.

3.5 ESP Lessons Learned as Described in ACRS Correspondence, November 19, 2007

Part 5 of Table 3 identifies the ESP lessons learned reported by the ACRS to the NRC Commission in ACRS correspondence dated November 19, 2007.

3.6 Would Dominion Prepare Another ESP (Versus a COL)?

A summary of the benefits of the ESP process is provided in Table 4. From a review of these benefits, one can conclude that for the North Anna project, the ESP process had tangible benefits. For a future potential nuclear site, Dominion would take into account the ESP benefits shown in Table 4, but the decision to pursue a future ESP would be based on detailed evaluations of the site of interest. Those evaluations would include a review of Dominion's knowledge of the site and environs, site characteristics, the local community's familiarity with and support for the nuclear option, etc. Thus, a decision to take advantage of the ESP process for a future site would be tied to the specifics of the site itself.

Significant benefits of the ESP process include confirming the original determination regarding the potential suitability of the site, early resolution of siting issues, deferring a technology decision until supported by the business case, and keeping the nuclear option open while monitoring market conditions. Each is discussed more fully below.

Site Suitability. The general suitability of the North Anna site was originally determined by Dominion during the site evaluation phase of the project which preceded preparation of the ESP application. (The results of that effort were reported separately to DOE under Cooperative Agreement DE-FC07-02ID14313.) However, the ESP application preparation process provided an additional opportunity to examine site suitability prior to significant investment in plant design and confirm that no site characteristics were considered to be "show stoppers" for site development. Because site selection is critical to project success, as any company moves forward toward new nuclear, the additional opportunity to assess site suitability afforded by the ESP process is a clear benefit.

Siting Issues. During the NRC Staff's review of the ESP application, interactions with state agencies brought to light concerns with the initial planned approach of once-through cooling for Unit 3. (Note: Unit 4 had always been envisioned to use closed-cycle cooling.) As a result of numerous discussions and consultations, Dominion elected to change the cooling water approach for Unit 3 from a once-through cooling system to a closed-cycle cooling system. The change was implemented through a revision to the ESP application. Although challenging at the time, the ESP process served the beneficial purpose of identifying and resolving a significant concern at an early stage of Dominion's planning for Unit 3. Taken in perspective, the effect on Dominion's cost and schedule would have been significantly more severe had this conceptual design change been made during the COL application process. Because a COL application involves the development of more robust design information compared to an ESP and the commitment of substantially more resources to support, Dominion would have suffered a significantly greater adverse impact to its overall plans for North Anna Unit 3 had this change only been identified and addressed as part of the North Anna 3 COL application.

Technology Decisions. The ESP application process, in conjunction with the plant parameters envelope approach, allowed Dominion to defer a technology decision until justified by the business case. Dominion did in fact change its original reactor technology selection for the North Anna 3 COL application while the ESP phase was still in process, with a relatively small impact on the Unit 3 program's time line.

The Nuclear Option. An ESP, once granted, is good for 20 years. This feature to "bank" the site has long been identified as a benefit of the ESP process. It acknowledges that market conditions can and do change, and that a prospective new plant operator must take market factors into account when deciding to go forward with a COL application. The ESP preserves a key component of that decision-making—

regulatory finality associated with site selection and suitability—while affording the prospective COL applicant the opportunity to monitor and evaluate market conditions. However, in this instance, market conditions and other factors led Dominion to not bank the ESP. Rather, Dominion moved directly from the ESP to the COL phase after having selected the ESBWR reactor technology.

4. Evolution of Industry and NRC ESP Guidance

This section describes the chronology of documents developed both by the nuclear industry and the NRC to provide guidance for preparing and reviewing ESP applications.

4.1 Overview

As industry attention was drawn to preparing ESP applications for submittal to the NRC, it became apparent that long-standing NRC guidance was not tailored for the ESP process. Existing guidance documents for preparing licensing applications, such as NRC Regulatory Guide (RG) 1.70, "Standard Format and Content of Safety Analysis Reports for Nuclear Power Plants (LWR Edition)," Revision 3, November 1978, and NRC Regulatory Guide 4.2, "Preparation of Environmental Reports for Nuclear Power Stations," Revision 2, July 1976, were many years out of date and founded on a different regulatory process (i.e., 10 CFR Part 50, rather than the newer Part 52).

The first effort to develop ESP guidance was initiated by industry in late 2001 in the form of NEI 01-02, "Guidance For Preparing An Early Site Permit Application." Although instructive, that effort was soon supplanted by an NRC initiative in 2002 to develop guidance designated NRC Review Standard RS-002, "Processing Applications for Early Site Permits."

In specialized areas, up-to-date guidance, primarily environmental, existed (e.g., NUREG-1555, "Standard Review Plans for Environmental Reviews for Nuclear Power Plants") but required some time for both NRC and industry to develop an understanding on how it should be applied to an ESP, particularly one based on a plant parameter envelope rather than a selected technology. Other draft guidance, primarily a draft 1996 version of NUREG-0800, "Standard Review Plan for the Review of Safety Analysis Reports for Nuclear Power Plants," had been developed by NRC to reflect changes as a result of the Part 52 process, but did not play a significant role in the development and/or review of ESP applications because of its draft status.

Most recently, in June 2007 the NRC Staff issued Regulatory Guide 1.206, "Combined License Applications for Nuclear Power Plants (LWR Edition)." Regulatory Guide 1.206 incorporated the lessons learned in the development of guidance to support ESP application and now serves as a comprehensive guidance document to applicants preparing COL applications.

Each of the major guidance documents is discussed in more detail below.

4.2 Discussion

NEI 01-02, Revision A, Guidance For Preparing An Early Site Permit Application

On September 28, 2001, the Nuclear Energy Institute (NEI) submitted NEI 01-02, Revision A, "Guidance For Preparing An Early Site Permit Application," to the NRC for review and comment. This guidance document was developed by the NEI Early Site Permit Task Force and the NEI New Plant Executive Task Force. The guidance provided an approach for implementing the requirements of 10 CFR Part 52, Subpart A, "Early Site Permits."

The process outlined in the document was founded on nascent industry experience in developing early site permit applications. Where appropriate, it pointed the user to applicable regulatory guidance. The industry's expectation was that using the guidance would make the process for preparing an early site permit application stable, predictable and efficient.

NEI did not request that NRC formally endorse the guidance in a regulatory guide, but sought some recognition from the NRC that the guidance was an ac-

ceptable approach for preparing early site permit applications.

The NEI guidance consisted of the following major parts and appendices:

- Introduction
- Overview of Part 52, Subpart A
- Filing and contents of Early Site Permit Applications
- Appendix A Regulations for Early Site Permits
- Appendix B: Acronyms and Terms
- Appendix C: Plant Parameters Envelope

On October 12, 2001, the NRC Staff provided an assessment to the Commission of the extent and adequacy of existing regulatory guidance in SECY 01-0188, "Future Licensing and Inspection Readiness Assessment." The Staff reported to the Commission its belief that, in general, sufficient guidance existed to support reviews of future applications, but that several areas would require revision of guidance documents.

On November 21, 2001, the NRC advised NEI that it had concluded that the NEI guidance document, NEI 01-02, did not appear to provide a complete summary of guidance currently available for developing an ESP application, and did not provide additional guidance to support such an effort. The NRC Staff declined to conduct further review. Instead, the NRC made general reference to its Regulatory Guides, Standard Review Plan, Environmental Standard Review Plan, and other documents as suitable guidance for preparing an ESP application.

Draft NRC Review Standard (RS) 002, "Processing Application for Early Site Permits"

Although the NRC declined to endorse the industry guidance, it soon embarked on its own. Little more than a year later, on February 6, 2003, the NRC issued Regulatory Issue Summary RIS 2003-03, "Release of Draft Review Standard (RS)-002, 'Processing Applications for Early Site Permits,' For Interim Use."

The RIS stated that three potential applicants [Ed. note: including Dominion] had notified the NRC that they intended to submit ESP applications in 2003, and that, consequently, the NRC had prepared staff guidance to ensure that these and subsequent applications would be reviewed in a consistent and thorough manner.

Draft RS-002 provided guidance for the NRC Staff to use in reviewing ESP applications. For each area of review, the draft review standard provided staff guidance on acceptance criteria, review procedures, and sample evaluation findings. To the extent feasible, the draft review standard referenced existing regulatory guidance, such as that found in NUREG-0800. For cases in which the available guidance predated 10 CFR Part 52, the NRC Staff provided guidance to reflect its applicability to the ESP process and to reflect the current regulatory framework. The annotated guidance, which was attached to the draft review standard, was intended only to address ESP applications.

Draft RS-002 became the main guidance document for the first ESP applicants, including Dominion, to prepare ESP applications and provided the basic roadmap to the staff into the more detailed technical guidance in the SRP and Regulatory Guide documents. For guidance on environmental issues, it deferred in large part to NUREG-1555, although it did offer some clarification.

A final version of RS-002 was issued by the NRC in May 2004.

NUREG-1555, "Standard Review Plans for Environmental Reviews for Nuclear Power Plants"

NUREG-1555, published in October 1999, provided guidance to the staff to implement provisions of 10 CFR 51, "Environmental Protection Regulations for Domestic Licensing and Related Regulatory Function," related to new site/plant applications. The NUREG superseded NUREG-0555, "Environmental

Standard Review Plans for the Environmental Review of Construction Permit Applications for Nuclear Power Plants," issued in 1978. New technical issues—such as environmental justice and severe-accident mitigation design alternatives—and new licensing structures—such as early site permits, combined licenses and license renewal—all served to justify the need for the NRC Staff to develop NUREG-1555.

(Although NUREG-1555 did not formally supersede Regulatory Guide 4.2, the practical effect was the same. Regulatory Guide 4.2, Revision 2, July 1976, provided guidance to assist prospective applicants in understanding the format and content of an environmental report. Although dated, it did offer some insight and continued to serve as a reference document.)

NUREG-1555, also commonly referred to as the Environmental Standard Review Plan, or ESRP, contains sections providing detailed instructions developed for the NRC Staff to use when conducting environmental reviews of applications related to nuclear power plants, specifically including ESP and COL applications. The ESRP provides specific instructions to the NRC Staff responsible for conducting environmental reviews, provided detailed descriptions of the manner in which the NRC reaches judgments on the kinds of environmental impacts caused by construction and operation of nuclear power plants, and specifies the means for determining the significance of these impacts. NRC then follows its NEPA practice of characterizing impacts as small, moderate, or large.

The ESRP has ten chapters. The chapters form a general outline for an EIS. The chapters are:

1. Introduction
2. Environmental Description
3. Plant Description
4. Plant Construction Impacts
5. Plant Operation Impacts
6. Environmental Monitoring
7. Impacts of Postulated Accidents
8. Need for Power
9. Alternatives
10. Environmental Consequences

An issue that had to be addressed by ESP applicants was that NUREG-1555 was intended as guidance to the NRC Staff. The latest environmental guidance specifically developed for use by applicants was Regulatory Guide 4.2, Revision 2, dated 1976, but the Regulatory Guide was not well aligned with the informational needs specified in NUREG-1555. Dominion, as well as the other ESP applicants, focused their efforts to develop environmental reports to be included in ESP applications that were responsive to the guidance and criteria in NUREG-1555. However, as previously noted, the guidance in Regulatory Guide 4.2 was considered in the development effort.

To its credit, the NRC Staff had created NUREG-1555 in 1999 to recognize the alternative licensing structure under 10 CFR Part 52, "Early Site Permits; Standard Design Certifications; and Combined Licenses for Nuclear Power Plants." Regulatory Guide 4.2, Supplement 1, "Preparation of Supplemental Environmental Reports for Applications to Renew Nuclear Power Plant Operating Licenses," issued in September 2000, was another valuable resource. It provided useful guidance regarding the inclusion in an application of information that was not addressed in the 1976 revision of Regulatory Guide 4.2, such as cumulative impacts and environmental justice.

5. ESP Project Execution

This section provides a description of the activities necessary to prepare an ESP application and support the NRC review and hearing. This description is based on experience from the North Anna ESP Project. Many of these activities would be similar to prepare a COL application.

5.1 Project Formation Activities

Project formation activities to begin an ESP project include:

- **Make decision to pursue new nuclear generation as an option**. This is a business decision

that would generally occur in advance of the decision to form an ESP project.

- **Perform site selection study**. The site selection study must satisfy the requirements of 10 CFR 51, 10 CFR 52, and NUREG-1555 (Section 9.3). Use of the "Siting Guide: Site Selection and Evaluation Criteria for an Early Site Permit Application (Siting Guide)," published by the Electric Power Research Institute in March 2002, is recommended.

- **Obtain project funding.** Project funding would be obtained by the entity forming the ESP project in accordance with its normal business practices.

- **Select the project team**. This includes in-house personnel, consultants, and contractors. Particular attention should be paid to the selection of the specialty consultants and contractors that may be needed to prepare the ESP application including subsurface investigation, geologic field investigations, geotechnical engineering, probabilistic seismic hazards analysis, hydrological evaluations, environmental investigation, legal, and document editing and publication.

- **Select the reactor design(s) that will be addressed in the ESP application**. The ESP application could take several approaches including using a general plant parameter envelope (PPE) (similar to the North Anna, Grand Gulf, and Clinton ESP applications), limited PPE (PPE concept focused on a reduced set of reactor designs rather than the general PPE), or design-specific information (similar to the Vogtle ESP application which addressed the AP1000 only). Depending on which approach is chosen, information and support from the reactor vendor(s) will be needed to support preparation and review of the ESP application.

- **Prepare project procedures and programs**. These will include the quality assurance program, project execution plan, engineering procedures, licensing and document control procedures, etc.

- **Develop the work breakdown structure, detailed project schedule, and cost estimate**. Table 5 provides a high-level table of contents for an ESP application. A project work breakdown structure should be established that is consistent with the various parts, chapters, and sections of the ESP application.

  Next, a detailed, resource-loaded project schedule should be prepared. The activities, durations, and resource estimates should be prepared with direct input from project personnel and should consider lessons learned, RAIs, and experience from previous ESP and COL projects. The schedule should be prepared at the section level of the ESP application. The activities necessary to prepare each "X.Y" section of the ESP application should be identified and resource-loaded in the project schedule. For some sections (particularly SSAR Sections 2.4 and 2.5), the schedule should be further broken down to the "X.Y.Z" level. Typical schedule activities to prepare an ESP application section include:

  — **Data collection** including internet searches, contacts with agencies and organizations, and requests for information that will be issued to the reactor vendor(s) or other team member companies.

  — **Conduct pre-section briefing**. Table 6 provides a suggested outline for a pre-section briefing which has been adapted from the Author Presentation approach used for the North Anna ESP Project. Pre-section briefings should be held early in the effort to prepare the section and can be conducted via meeting, conference call, video conference, webcast, etc.

  — **Perform detailed calculations, analyses, and engineering design activities**. The development of the various sections of the ESP application will necessitate a significant amount of supporting engineering and analysis work. Table 7 lists the types of activities which can vary from project to pro-

ject. The schedule should show the origination, independent review, and approval activities for each product.

— **Prepare draft section**. Draft sections should include not only the text, tables, and figures that will be placed in the ESP application, but also the supporting regulatory conformance tables and validation package. Any open items should be clearly identified for later resolution.

— **Perform licensing, legal, management, and coordination reviews**. It is important to perform a full review as draft sections are issued so as to avoid a "bow wave" effect later.

— **Resolve review comments**. Comments should be addressed and their resolution reviewed with the commenter to confirm that the comment was correctly understood and dispositioned appropriately.

— **Issue final section**. Issuance of the final section should be in the form of a polished document and supporting materials, including conformance tables, validation package, and identification of any open items.

The schedule should also identify the following activities:

— **Team reviews of compiled chapters**. After the final versions of all sections of a chapter are completed, a team review of the compiled chapter should be performed.

— **Page-turn reviews**. Once all chapters and parts have been completed, "page-turn" reviews of the complete, compiled COLA should be performed.

— **Pre-application interactions with NRC and state and local agencies**. The NRC affords potential applicants the opportunity for interaction prior to assuming the more formal status of "applicant" and the constraints that are imposed by the governing regulations. Potential applicants should take full advantage of the opportunity. Similarly, the pre-application period offers the opportunity for early interaction with state and local agencies in an informal manner that will serve the applicant well during the more formal licensing process. In particular, early consultation with state agencies concerning the proposed cooling water systems, aquatic impacts, and process for obtaining related certifications under the Clean Water Act and Coastal Zone Management Act should be discussed.

Critical Path. Particular attention should be paid to the critical path and near-critical paths to ensure the activities, durations, and logic ties are well understood and accurately reflected in the project schedule. Depending on the project, critical and near-critical paths could include:

— SSAR Section 2.5, including the subsurface investigation, laboratory analyses, and the numerous geotechnical and seismic analyses.

— SSAR Section 2.4, including the subsurface investigation, collection of groundwater data, and the hydrological evaluations.

— SSAR Section 2.3 (and the corresponding ER section) regarding the atmospheric dispersion analyses, including the collection and verification of onsite meteorological data and the dispersion analyses.

— Cooling water sections for the environmental report including the evaluation of alternatives, conceptual design and analysis, and evaluation of impacts.

5.2 Application Preparation

All work to prepare the ESP application should follow the detailed project schedule. Good practices are identified below.

- **Regulatory Conformance**. The ESP application should be prepared to conform to applicable NRC regulations and guidance. Any deviations from these guidance documents should be identified and fully justified. Lessons learned and RAIs from previous ESP and COL projects should also be specifically considered during section preparation. NRC guidance documents applicable to parts of the ESP application include:

  — Part 1 – General and Administrative Information; Regulatory Guide 1.206.

  — Part 2 – Site Safety Analysis Report; RS-002, Regulatory Guide 1.206, NUREG-0800, and other Regulatory Guides.

  — Part 3 – Environmental Report; NUREG-1555.

  — Part 4 – Programs and Plans; RS-002, Regulatory Guide 1.206, NUREG-0800, NUREG-1555, and other Regulatory Guides.

- **Pre-Application Interactions**. The project team should expect and fully support pre-application interactions with the NRC Staff and their contractors. For the North Anna ESP project, Dominion had multiple contacts with the NRC Staff prior to submitting the ESP application. Beginning with direct conference calls and meetings at NRC headquarters for process inquiry and notification of the proposed action and intended efforts, Dominion also met with other interested industry representatives at forums and meetings. Of utmost importance was the ever-open offer by Dominion to invite and host NRC visitors to the North Anna site and/or local support offices. Face-to-face interactions went a long way to support communications and understanding of meeting regulatory needs. The NRC also visited the North Anna region to meet with other state agencies, local government representatives, and local community associations. This facilitated the open-to-the-public process, was effective in delivering information about the NRC licensing process, and left no surprises as to Dominion's intentions and analyses.

- **Weekly status conference calls**. Weekly conference calls should be conducted with key members of the project team, subcontractors, and consultants to review critical issues, schedule progress, action items, interface issues, upcoming activities, etc. Separate weekly review meetings on specific application sections (e.g., SSAR Section 2.5) are also recommended to allow for further detailed discussions outside the weekly project status meeting.

- **Pre-section briefings**. Pre-section briefings should be held for each ESP application section. Efforts should be made to ensure that the section preparation effort directly follows the pre-section briefing. This will maximize the benefits of the discussions and the exchange of ideas and approaches from the pre-section briefing. Additionally, pre-job briefings should be used for complicated work activities.

- **Document publication**. Several activities should be completed early in the effort including selection of the software that will be used to publish the ESP application, creation of the Writer's Guide and author training, and creation of the electronic template(s) for the application.

5.3 Support of NRC Review and Hearing

Following acceptance of the application for review, the NRC will publish a schedule outlining the major milestones for the safety and environmental reviews. Good practices to support the NRC review effort and hearing include:

- **Frequent and routine communication**. Conference calls and meetings should be used to ensure good communication with the NRC Staff. A significant amount of coordination with state and local agencies will also be needed, particularly if these agencies are reviewing related permit applications (e.g., water permits, Coastal Zone consistency certification).

- **Responding to RAIs and submitting application revisions**. Procedures and processes for efficiently preparing responses to NRC RAIs and application revisions should be developed and implemented before the application is submitted. The NRC typically expects that responses to RAIs will be submitted in approximately 30 days or less in order to maintain their published review schedule. RAI responses should include an identification of any corresponding application changes that will be incorporated into the ESP application in a later revision.

- **ASLB Questions**. Beyond the RAIs issued by NRC Staff to support their safety and environmental reviews, the ASLB will also issue questions requesting coordinated responses from the applicant and NRC Staff. The effort to respond to ASLB questions should not be underestimated and will likely require access to numerous technical experts, including experts that may have completed their work several years earlier and are no longer actively supporting the project.

5.4 Expected Schedule

Expected schedule durations for an ESP project are as follows:

- 6 to 9 months for prerequisite activities (decision to proceed, siting study, project funding).

- 15 to 24 months for project formation and preparation of the ESP application. This will vary depending on site- and project-specific issues.

- 24 months for the NRC safety and environmental reviews. This is based on the NRC review schedule for the Vogtle ESP.

- 6 to 12 months for the hearing.

6. References

1. 10 CFR Part 52, "Early Site Permits; Standard Design Certifications; and Combined Licenses for Nuclear Power Plants," U. S. Nuclear Regulatory Commission.

2. 10 CFR 51, "Environmental Protection Regulations for Domestic Licensing and Related Regulatory Function," U. S. Nuclear Regulatory Commission.

3. NUREG-0555, "Environmental Standard Review Plans for the Environmental Review of Construction Permit Applications for Nuclear Power Plants," U. S. Nuclear Regulatory Commission, 1978.

4. NUREG-0800, "Standard Review Plan for the Review of Safety Analysis Reports for Nuclear Power Plants," U. S. Nuclear Regulatory Commission, Draft 1996.

5. NUREG-1555, "Standard Review Plans for Environmental Reviews for Nuclear Power Plants," U. S. Nuclear Regulatory Commission, October 1999.

6. NUREG-1811, "Environmental Impact Statement for an Early Site Permit (ESP) at the North Anna ESP Site," U. S. Nuclear Regulatory Commission, December 2006.

7. NUREG-1835, "Safety Evaluation Report for an Early Site Permit (ESP) at the North Anna ESP Site," U. S. Nuclear Regulatory Commission, September 2005, and Supplement 1, November 2006.

8. Regulatory Guide 1.70, "Standard Format and Content of Safety Analysis Reports for Nuclear Power Plants (LWR Edition)," U. S. Nuclear Regulatory Commission, Revision 3, November 1978.

9. Regulatory Guide 1.165, "Identification and Characterization of Seismic Sources and Determination of Safe Shutdown Earthquake Ground Motion, "U. S. Nuclear Regulatory Commission, March 1997.

10. Regulatory Guide 1.206, "Combined License Applications for Nuclear Power Plants (LWR Edition)," U. S. Nuclear Regulatory Commission, June 2007.

11. Regulatory Guide 1.208, "A Performance Based Approach to Define Site Specific Ground Motion," U. S. Nuclear Regulatory Commission, March 2007.

12. Regulatory Guide 4.2, "Preparation of Environmental Reports for Nuclear Power Stations," U. S. Nuclear Regulatory Commission, Revision 2, 1976.

13. Regulatory Guide 4.2, "Preparation of Supplemental Environmental Reports for Applications to Renew Nuclear Power Plant Operating Licenses," U. S. Nuclear Regulatory Commission, Supplement 1, September 2000.

14. Regulatory Guide 4.7, "General Site Suitability for Nuclear Power Stations," U. S. Nuclear Regulatory Commission, Revision 2, April 1998.

15. Review Standard RS-002, "Processing Applications for Early Site Permits," U. S. Nuclear Regulatory Commission, May 3, 2004.

16. "Staff's Implementation of Lessons Learned from Reviews of Early Site Permit Applications," Letter from William J. Shack, Chairman, U. S. Nuclear Regulatory Commission, Advisory Committee on Reactor Safeguards, to The Honorable Dale E. Klein, Chairman, U. S. Nuclear Regulatory Commission, November 19, 2007.

17. "North Anna Early Site Permit Application," Dominion Nuclear North Anna, LLC, September 25, 2003.

18. NEI 01-02, "Guidance For Preparing An Early Site Permit Application," Nuclear Energy Institute, Revision A, September 2001.

19. "Siting Guide: Site Selection and Evaluation Criteria for an Early Site Permit Application (Siting Guide)," Electric Power Research Institute, March 2002.

20. "Report of the Combined License Review Task Force," U. S. Nuclear Regulatory Commission, COMDEK-2007-001/COMJSM-2007-001, April 18, 2007.

21. Presentation to the Advisory Committee on Reactor Safeguards, Subcommittee on Early Site Permits, Dominion Nuclear North Anna, LLC, September 6, 2006, NRC ADAMS Accession Number ML062690274.

Table 1. Schedule Milestones	
Date	**Description**
July 1, 2002	Project start
September 25, 2003	Revision 0 of the Early Site Permit Application (ESPA) submitted to NRC
October 2, 2003	Revision 1 of the ESPA submitted to NRC
December 8, 2003	Environmental scoping meeting
December 11, 2003	NRC environmental audit at the North Anna site
January 9, 2004	End of environmental scoping period
Mary 3, 2004	Hearing Requests and Contentions filed
June 22, 2004	ASLB prehearing conference completed
July 15, 2004	Revision 2 of the ESPA submitted to NRC
August 6, 2004	ASLB decision to admit two contentions: ▪ EC 3.3.2 – Impacts of increased water temperature on striped bass in Lake Anna and downstream ▪ EC 3.3.4 – No-action alternative to the use of Lake Anna water for cooling Unit 3
September 7, 2004	Revision 3 of the ESPA submitted to NRC
December 10, 2004	DEIS issued
December 20, 2004	DSER issued
January 6, 2005	ASLB order dismissing contention EC 3.3.4 (based on settlement)
February 17, 2005	Public meeting to discuss DEIS
March 2, 2005	ACRS subcommittee meeting on DSER
March 3, 2005	ACRS full committee meeting on DSER
March 11, 2005	ACRS interim letter to Commission
May 12, 2005	Revision 4 of the ESPA submitted to NRC
June 16, 2005	FSER issued
June 16, 2005	ASLB decision granting in part and denying in part summary disposition on contention EC 3.3.2
July 6, 2005	ACRS full committee meeting on FSER
July 18, 2005	FEIS issued
July 18, 2005	ACRS letter to Commission
July 25, 2005	Revision 5 of the ESPA submitted to NRC
October 4, 2005	FSER issued as NUREG-1835
October 24, 2005	Dominion letter notifying the NRC of its intent to change cooling water approach
January 13, 2006	ESPA Supplement submitted to NRC
April 13, 2006	Revision 6 of the ESPA submitted to NRC

Table 1. Schedule Milestones	
Date	**Description**
June 27, 2006	Revision 7 of the ESPA submitted to NRC
July 7, 2006	Supplemental DEIS Issued
July 31, 2006	Revision 8 of the ESPA submitted to NRC
August 15, 2006	Public meeting to discuss DEIS
August 16, 2006	VDEQ public hearing on the Coastal Zone review
September 12, 2006	Revision 9 of the ESPA submitted to NRC
September 28, 2006	Supplemental FSER issued
October 24, 2006	ASLB decision granting summary disposition of contention EC 3.3.2
November 20, 2006	Supplemental FSER issued as NUREG-1835, Supplement 1
December 15, 2006	FEIS issued as NUREG-1811
January 18, 2007	ASLB questions on FSER issued
February 8, 2007	ASLB questions on FEIS issued
February 8, 2007	ASLB limited appearance session
March 20, 2007	ASLB hearing order
April 26, 2007	ASLB mandatory evidentiary hearing on uncontested issues completed
June 29, 2007	ASLB initial decision
November 20, 2007	Commission decision
November 27, 2007	ESP issued
February 2008	Project summary report issued

Table 2. Opportunities to Enhance the Regulatory Process Based on Lessons Learned

No.	Background/Description	Lessons Learned and Enhancement Opportunities
1	During the course of the ESP application review process, it was evident that state and local regulatory agencies were not familiar with the ESP process and were not attuned to the NRC Part 52 process.	ESP and COL applicants should assume the state and local regulatory agencies are unfamiliar with the NRC nuclear licensing processes and, therefore, the project should be prepared to provide significant background education and support to the agencies. As NRC has gained experience, it too has developed a more robust process of informing potential stakeholders when potential applicants identify their interest in a particular site. DOE should continue to support and expand its public information initiatives related to new nuclear generation.
2	The Generic Plant Parameter Envelope (PPE) table (SSAR Table 1.3-1 and ER Table 3.1-1) lists over 150 bounding parameters. Roughly one-third of these parameters were not used since site-specific values were developed in the ESP application. Of the remaining two-thirds, most were not considered at all as they were not relevant to the ESPA. The PPE included Generation III, Generation III+, and Generation IV reactor designs. The range of reactor technologies selected included designs that were not suitable for near-term deployment, but were reasonable given the duration of an ESP. The PPE concept was challenging to apply because NRC regulations and guidance for ESPs had not originally envisioned such a concept.	The PPE approach is useful to companies considering new nuclear and is an approach that should continue to be supported by the industry and NRC. However, some improvements to the approach used in the North Anna ESP application are warranted: • The set of parameters included in the PPE should be only those directly related to topics evaluated during the NRC's safety and environmental reviews. • When used, the applicant's PPE approach should be carefully considered and reviewed with the NRC in pre-application interactions. • Future applicants should consider a more limited set of reactors when assembling the PPE to improve NRC review efficiency.
3	The PPE table was created based upon data received from the reactor suppliers. The bounding values were determined by Dominion based upon a comparison of the parameters provided by each vendor. As a result of discussions with the NRC and in preparing responses to RAIs, Dominion elected to create a site characteristic and design parameter table specific to North	The generic PPE table should have been removed from the ESP application after the creation of the North Anna specific site characteristic and design parameter table. The fact that both sets of tables remained in the ESP application confused the NRC reviewers, particularly those involved with the environmental review.

Table 2. Opportunities to Enhance the Regulatory Process Based on Lessons Learned		
No.	**Background/Description**	**Lessons Learned and Enhancement Opportunities**
	Anna that, in essence, replaced the PPE table. However, the generic PPE table remained in the ESP application.	
4	An ESP application can be for a specific reactor design or for a range of designs, i.e., a PPE. The PPE can be for few or many designs, and can comprise current and/or future generation designs. The more complex the PPE, the more challenging and potentially less definitive the NRC review.	The PPE concept should be retained and supported. The NRC should continue to provide guidance to applicants who wish to prepare and submit ESP applications based on a PPE approach. DOE should continue to support such an approach as a critical component of the licensing framework for new nuclear plants.
5	As part of an ESP application, the applicant is required to demonstrate that there are no impediments to emergency planning for the chosen site. Beyond that, the applicant has the option of including a "major features" emergency plan or a full and integrated emergency plan. Dominion included the "major features" option in its ESP application. The benefit of the major features approach has not been readily discernable and the option has been viewed by some as having no benefit. The primary concern is that the same major features approved during ESP stage are re-visited in substantially more detail during the COL process. The resulting impression is that work is being done twice with little or no benefit.	It is Dominion's view that the assessment of the benefits of the "major features" alternative for emergency planning is premature. At the time of this report, it remains unknown whether the major features approach will result in either a cost or schedule savings for Dominion's North Anna COL application in the emergency planning area. The major features approach for an ESP does appear to be a potential benefit for ESP applicants who select a greenfield site. The early resolution of key elements of an emergency plan (i.e., major features) may be beneficial to support the development of a complete and integrated emergency plan that would be included in a subsequent COL application. Early acceptance of the major feature at the ESP phase would reduce the risk that resources expended subsequently to develop the supporting details were mis-spent because the major feature was considered unacceptable.
6	The NRC has no guidance regarding the use of data acquired from the internet.	Dominion chose to attempt to verify internet data sources that were used in the SSAR for those sections that are quality-related. This turned out to be only four sets of data. Weather data obtained from the National Climatic Data Center was validated. One set of internet data from the Coastal Services Center department of NOAA could not be validated. This same lesson-learned was identified by the ACRS. No action by the NRC to address this topic has been identified. DOE support to encourage NRC to develop such guidance would be appropriate.

Table 2. Opportunities to Enhance the Regulatory Process Based on Lessons Learned		
No.	**Background/Description**	**Lessons Learned and Enhancement Opportunities**
7	As defined in NUREG-1555, Section 9.3, Alternative Sites, the "Region of Interest" (ROI) is the geographic area under consideration for the 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. 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 from a regulated to a market-based approach 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 definition of ROI and its guidance regarding the identification of candidate sites as alternatives to the proposed site. The NRC should expand the "Region of Interest" discussion in its guidance that takes the deregulated market environment into consideration as well as the traditional cost-of-service approach.
8	Regulatory guidance indicates that for safety-related facilities, the maximum snow load should be determined considering the 100-year ground snow load and the 48-hour winter probable maximum precipitation (PMP) depth. During the North Anna ESP review, much discussion centered on how these two items were to be considered, whether the combination of these two events was too conservative, and if the combination of these events should be considered at the ESP or COL permit application. As a result of these discussions, the NRC position was determined for the ESP as stated in the next column.	The NRC position, as stated in the North Anna ESP FSER, is that the snow loads for safety-related structures should be based on the 100-year snowpack or snowfall, whichever is greater, recorded at ground level, plus the weight of the 48-hour winter PMP at ground level for the month corresponding to the selected snowpack. A COL applicant may choose and justify an alternative method for defining the extreme load combination of maximum snow load and winter precipitation load by demonstrating that the 48-hour winter PMP could neither fall nor remain on the top of the snowpack and/or building roofs because of the specified design of the roof.

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9	ESP applicants are expected to collect substantial amounts of historical information. The decision of which set of historical information, or the location from which the information is to be collected, is fundamental to meeting NRC requirements. Because the information can often be collected from more than one source, the decision of which source or sources to use can have an impact on a project's cost and schedule if re-work is required based on NRC feedback that a "better" source of information should have been used.	ESP applicants should strive to reach early agreement with the NRC Staff during pre-application discussions regarding the source(s) of site and regional historical information. Examples of such information categories include meteorological, hydrological, and geological information.
10	Review the development and study of long-term weather cycles for periods of up to 100 years.	The NRC's Advisory Committee on Reactor Safeguards (ACRS) has commented that "The staff has made appropriate modifications to the Standard Review Plan to recognize that there are cycles in the weather. Such cycles are especially well known for the east coast of the United States. The staff has made contact with knowledgeable technical societies, will be attending pertinent scientific conferences, and is proposing research studies of trends in the frequencies and intensities of hurricanes." In brief, the ACRS is concerned about the potential impact on global warming as it relates to nuclear safety and the environment and is encouraging the staff to develop a regulatory position. DOE should support the NRC's efforts to develop a position on this subject so that it can be appropriately and consistently addressed in future permit and license applications.
11	NRC requirements in the Code of Federal Regulations are written in a concise manner. The NRC expands on those requirements by providing guidance illustrating acceptable ways to meet the requirements. It is not unusual for permit and license applicants to be similarly concise in their submittals. However, in such instances, the NRC may issue a request for additional information (RAI) soliciting the details and descriptions that "tell the story."	ESP and COL applicants should be proactive in providing information at the outset sufficient for the NRC to make its required findings. In addition, applicants need be mindful that the NRC feels a strong obligation to communicate openly with the public regarding its activities. The additional effort by applicants to "tell the story" in ESP and COL applications as they are prepared will serve to preclude a substantial number of RAIs.

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12	Although the NRC is the primary licensing authority for an ESP or COL, it works in coordination with other federal, state, and local government agencies to discharge its responsibilities.	ESP and COL applicants must be mindful that regulatory agencies other than the NRC will have an impact on the review and approval of the application. Applicants should be proactive in identifying and interacting with those agencies early in the licensing process. The interactions should address both the applicant's business goals, a description of the NRC regulatory process, and specific areas where state and/or local agency consultation, certification or approval will be required.
13	The NRC held a pre-application public meeting in April 2003 to inform the public of the expected submittal by Dominion of an ESP application later that year and to provide the public with information regarding the NRC licensing process. The NRC also conducted pre-application site visits to assess Dominion's data collection techniques and quality processes.	Pre-application visits by the NRC were beneficial to NRC, Dominion, other affected agencies, and the public. The NRC continues to develop alternative approaches to enhance and refine their pre-application interactions based on schedule and other considerations. These efforts should include pre-application interactions on environmental and safety review topics. DOE should continue to encourage and support NRC efforts in this area.
14	The North Anna ESP application was revised nine times by Dominion over the course of the NRC's review. (By way of comparison, the Clinton ESP application was revised four times and the Grand Gulf ESP application twice.)	Application revision frequency is not an indication of application quality, or the lack thereof. Each ESP and COL application is reviewed by the NRC for acceptance, a process by which the NRC determines that the application is accurate and complete, and that it contains sufficient information for the NRC to conduct its technical review. In Dominion's view, revising the ESP application periodically to incorporate responses to NRC questions was beneficial and Dominion possessed the publication capability to achieve that goal. ESP and COL applicants are encouraged to develop change processes and publication tools such that the option to revise as frequently as needed or desired is available.
15	During the course of its safety and environmental review, the NRC issued requests for additional information to Dominion. Dominion prepared responses to the NRC RAIs. As part of the process, Dominion evaluated the impact of the	Dominion prepared responses to several hundred NRC requests for additional information. In Dominion's view, the optimum time to assess the impact of an RAI response on the ESP application was concurrent with preparing the response. Then, offering that assessment to the NRC concurrent with the response provided

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	response against the content of the ESP application. If the response impacted the application content, Dominion included an assessment in the RAI response of how the application would be revised to reflect the response.	NRC reviewers with a context in which to evaluate the new information. The set of RAI responses, including the impact assessment on the ESP application, later served as a primary input to revise the application in an efficient and timely manner. ESP and COL applicants are encouraged to develop processes that provide for assessing the impact of RAI responses on application content concurrent with preparing the responses so that application revisions will be accurate, timely, and complete.
16	The NRC's technical review of the ESP application was divided into safety and environmental reviews. The NRC organization was structured similarly, with lead safety and environmental project managers. This resulted in different processes to request additional information. On the safety side, the NRC first provided RAIs to Dominion in draft form and afforded Dominion the opportunity to discuss the draft RAIs, including an assessment of the time required to respond. On the environmental side, the NRC process was essentially the opposite: NRC first issued the formal RAI and then afforded Dominion the opportunity to discuss and clarify the RAIs.	In Dominion's experience, the RAI process implemented by the NRC on safety issues was efficient and effective. It provided early opportunity to discuss the NRC's concerns when the questions were in a formative stage. As a result, the NRC sharpened its focus in the final version of the RAI, Dominion was generally able to provide a timely response because it better understood the issue and the NRC better understood what the applicant was capable of providing, and on several occasions, the need for the NRC to actually issue the RAI was eliminated. This approach proved superior to the process used for environmental RAIs. Environmental RAIs were issued without notice in final form, the NRC was less willing to revise the RAI once issued, and any dialog regarding the question took place "on the clock," i.e., within the time period established by the NRC in the transmittal letter to respond. Near the end of the technical review, NRC management acknowledged the difference in the processes and designated one project manager as overall lead to standardize the process. Since that time the NRC has continued the policy of an overall project lead, but because of the continuing organizational alignment within the NRC and subject matter differences, the tendency for the safety and environmental RAI process to diverge remains. ESP and COL applicants should be mindful of this tendency and take appropriate actions, when necessary.

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17	The ASLB hearing process represents another opportunity to respond to NRC questions, this time submitted by the licensing board. The board has substantial latitude in defining the process to be followed.	For the North Anna ESP, the board was willing to employ a process similar to that used by the NRC Staff to facilitate its safety review. Nonetheless, ESP and COL applicants should be prepared to answer numerous questions on a rigorous schedule established by the board to support the legal proceeding. For the North Anna ESP application, the board directed Dominion and the NRC Staff to work together to prepare responses to the board questions. This resulted in a significant efficiency.
18	If a COL application references an early site permit, 10 CFR 51.50(c)(1) requires that the COLA Environmental Report include "any new and significant information for issues related to the impacts of construction and operation of the facility that were resolved in the early site permit proceeding."	Specific regulatory guidance to implement the "new and significant" requirements of 10 CFR 51.50(c)(1) has not yet been issued by the NRC. As part of Dominion's efforts to prepare the North Anna COLA, a rigorous, multi-step process was implemented to identify new and significant information for inclusion in the COLA Environmental Report. At this time, it is uncertain if Dominion's "new and significant" process will meet the NRC's expectations for the information that must be included in the COLA Environmental Report. The reviews of the North Anna and Grand Gulf COLAs, which both reference ESPs, should result in a better understanding of the "new and significant" process.
19	NRC guidance is now more robust and reflects the Part 52 ESP and COL licensing process. The ESP process has been demonstrated and the NRC has worked to improve the efficiency of its review process. Is it reasonable to expect future ESP application reviews to occur in less time, or require fewer resources?	For the first three ESP applications, the overall time was as follows: • North Anna: September 2003 – November 2007; 50 months • Clinton: September 2003 - March 2007; 42 months • Grand Gulf: October 2003 – March 2007; 41 months The Vogtle ESP application was submitted in August 2006 and the NRC Staff review is scheduled to be completed by September 2008, a total of 25 months. Assuming a 12 month duration for the mandatory hearing following the NRC Staff review, the total time for Vogtle would be 25 plus 12, or 37 months. This suggests that some efficiencies are being realized as a

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		result of the first three ESP applications piloted under DOE's NP 2010 Program. DOE should continue to encourage and support the NRC's efforts to further improve the efficiency of their safety and environmental reviews and, thus, reduce the resources and time required to review ESP and COL applications.
20	A mandatory hearing is required under current NRC regulations. The North Anna ESP application hearing was uncontested, all contentions having been previously dismissed by the hearing board. The final safety and environmental documents were issued by the NRC Staff at the end of 2006; the permit was issued in November 2007. Could efficiencies be gained in the hearing process?	In April 2007, the NRC Combined License Review Task Force, headed by then Commissioner Merrifield, presented several recommendations to the Commission to improve the licensing process, including recommendations specifically targeting the mandatory hearing. (Reference: COMDEK-2007-001/COMJSM-2007-001). The task force recommended that the Commission revise 10 CFR 2.104 to reflect a policy that a contested hearing for a combined license application fulfills the requirement in section 189a.(1)(A) of the Atomic Energy Act that the Commission shall hold a hearing ... on each application for a construction permit .... Under the recommended policy, there would be a hearing on uncontested issues only if there were no hearing on contested issues; and any hearing on uncontested issues would be conducted by the Commission itself. The task force also recommended that the Commission request legislative authority from Congress to eliminate the statutory requirement for a mandatory hearing (i.e., a hearing on uncontested issues). On June 22, 2007, the Commission approved the task force proposal that the Commission itself conduct the mandatory hearing (in the absence of legislation eliminating the requirement for a hearing even if a request for hearing is not made). The Commission continues to have the authority and discretion to request that the ASLBP conduct a hearing in a particular case. The NRC's Office of General Counsel was directed to prepare a plan for the conduct of these hearings by the Commission modeled after the Browns Ferry restart meeting and the Calvert Cliffs and Oconee license renewal meetings. The Commission also approved obtaining legislative

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		authority from Congress to eliminate, from Section 189a of the Atomic Energy Act, the statutory requirement to conduct a hearing if no one has asked for a hearing. A significant schedule reduction could be realized by eliminating the mandatory hearing, when appropriate, or conducting the mandatory hearing in the manner recommended by the task force. DOE should work with the NRC and Congress to support these proposed enhancements to the NRC regulatory framework.

Table 3. Lessons Learned		
No.	**Background/Description**	**Lessons Learned**
Part 1 – Lessons Learned for Project Management		
1-1	Author Presentations were considered to be beneficial by most project participants.	Continue practice and initiate as early as possible in the project's schedule. Author Presentations were felt to be one of the strengths of the entire program to produce the application. Use Author Presentations or a similar approach to develop sound technical approaches for resolving all regulatory issues, site limitations, and engineering concerns early in the project. Include Author Presentations or pre-section briefings as milestones on the master project schedule. This was identified as a **Best Practice**. The Author Presentation process (using a "Basis Document" format) was employed for the North Anna COL Application to confirm author "buy-in", ensure that the review team agrees with author approach, and agree on section strategy prior to large-scale authoring investment in time.
1-2	Detailed planning and scheduling, action item lists, and weekly schedule meetings greatly facilitated the identification of problem areas and schedule impacts.	Continue practice. This was identified as a **Best Practice.**
1-3	Throughout the document preparation, several project activities required pre-job briefings. These activities included complicated analyses such as the cooling water analysis, offsite dose analysis, and some of the geotechnical/seismic analyses.	The "pre-job briefing" process was identified as a **Best Practice**.
1-4	The cooling water approach was changed after initial submittal of the ESP application based on input from state agencies.	Future projects should plan on a very proactive, early engagement with state and local agencies and concerned citizens.
1-5	The resurgence of the nuclear industry and the ESP/COL permitting activities involves the use of engineers and scientists who may not have an in-depth exposure to the demands of creating a complex application with zero defects. Resources for the work come from a variety of backgrounds and experience.	Mandate significant training of authors, checkers, licensing reviewers, etc., that focuses on the need to prepare permit applications with zero defects. Project managers must fully recognize that not all project participants have the same level of experience, and many project participants may be working on their first NRC submittal of any

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No.	**Background/Description**	**Lessons Learned**
		magnitude.
1-6	Some section authors failed to identify all existing information, applicable regulatory requirements and guidelines, and their interface.	Institutionalize front-end planning requirements.
1-7	Many issues need to be addressed in more than one section of the ESP application, either the SSAR and/or the ER. Several team members felt that this could have been handled more efficiently. The way in which transmission systems was handled was cited as an example.	The approach (strategy) to be employed for these issues needs to be communicated clearly to each affected author. These common issues could have been the subject of additional Author Presentations to stress the themes or strategies to be employed in multiple affected sections.
1-8	The project schedule was built under the assumption that combined comments from all Dominion departments would be received. In some instances the comments from the Dominion legal department were received in separate review packages. This led to some confusion and inefficiency in the comment incorporation process.	All groups, including legal, should be involved in the process at an early stage to avoid late comments that will cause significant rework. For example, the legal group could have been included in the Author Presentation process.
1-9	Bechtel's work included coordination with four subcontractors who each had a significant scope of work for the ESP effort.	As this was a first-of-a-kind effort, the amount of time required to coordinate with the subcontractors was underestimated in the project budget. Experience has shown that interface with subcontractors is a significant effort to integrate their work and produce a quality application.
1-10	Dominion’s in-house ESP team was small, initially comprised of five full time people. Because of the small team and their backgrounds, some felt that they were not well suited to author some of the sections assigned.	At project inception, and periodically throughout the project, the team should re-evaluate the responsibility for application sections based on the experience of the individuals, workload, and other factors. Be ready to adjust.
1-11	Dominion’s in-house ESP team was small, initially comprised of five full time people. Because of the small team and their backgrounds, some sections were assigned to off-project personnel.	Develop formalized training for off-project personnel. Continuously evaluate the need for additional indoctrination and training throughout the project.

Table 3. Lessons Learned		
No.	**Background/Description**	**Lessons Learned**
1-12	A Level 3 schedule was created that identified dates by when first draft (Revision A) sections should be issued for review.	For a document of the size and complexity of an ESP or COL application, it is critical that the intermediate scheduled dates are met for each issue of the document's revisions. Delays in the preparation of the initial submittals serve to aggravate the "bow-wave" when too many sections must be reviewed and approved at the end of the schedule.
1-13	Three weeks were allowed for review and comment of Revision A sections.	For a document of the size and complexity of and ESP or COL application, it is critical that the intermediate schedule dates are met for each issue of the document's revisions. Delays in the preparation of the initial submittals serve to aggravate the "bow-wave" when too many sections must be reviewed and approved at the end of the schedule. The project schedule should recognize that some sections require more extensive, longer reviews than other sections. All groups must exhibit higher discipline at the front end of the schedule so the "bow wave" effect can be avoided.
1-14	The detailed project schedule was keyed to the submittal of Revision A packages. Supporting calculations and analyses were not specifically identified on the schedule in some cases. Separate schedules were prepared to track calculation and analysis issues.	The detailed project schedule should specifically include each calculation/analysis that must be performed to support the application, including the origination, checking, and approval steps.
1-15	The project schedule was created based upon detailed discussions with authors/supervisors and attempted to show logic ties from one section to another. Despite this effort, some inputs/output relationships on the schedule were not properly captured.	Additional emphasis should be placed on front end scheduling to capture all section schedule logic ties. This is a significant effort.
1-16	The time and resources necessary to support the NRC's pre-application audit were much greater than originally estimated. These efforts included advance communication and arrangements, site and area tours, travel by technical experts to the site to support the audit, etc.	Additional emphasis, planning, and resources should be implemented to support pre-application interactions with the NRC Staff.

Table 3. Lessons Learned		
No.	**Background/Description**	**Lessons Learned**
Part 2 – Lessons Learned for Author and Licensing Personnel		
2-1	The application review process included a "Team Review" or "Page Turn" of the compiled document.	This was identified as a **Best Practice** for the project and served to improve the consistency of language and approaches to multiple sections.
2-2	The NEI ESP Task Force guidance and draft NRC Review Standard RS-002 were issued well after project start and caused rework.	For the North Anna ESP application, a revision to the NRC's review standard for Early Site Permits, RS-002, was under development as the project was scoped and execution commenced. RS-002 contained requirements in the meteorological area that were not fully recognized or addressed in time for the initial submittal of the ESP Application. This prompted RAIs from the NRC and required a response and a subsequent revision to the application. This was the result of the project being an industry first-of-a-kind effort. However, future ESP and COL application preparation efforts should take into account the schedule impact of changing regulations, standards, guidance.
2-3	A common problem found in early section drafts was that descriptions of the same information presented in multiple sections were not consistent — even when originated by the same author.	Mandate in-depth classroom training regarding the author, checker, and licensing review responsibilities.
2-4	RS-002, Section 2.4.13, requires analysis of accidental releases of liquid effluents in ground and surface waters. Radionuclide inventories cannot be adequately characterized at the ESP stage to complete a meaningful performance assessment that would comply with RS-002.	Include on the PPE a liquid radionuclide inventory that would allow a quantitative performance assessment.
2-5	The preparation of SSAR Section 2.5.2, Vibratory Ground Motion, relied heavily on the application of untested regulatory guidance in Regulatory Guide 1.165. This introduced inefficiencies and rework in order to satisfy different interpretations of the guidance and the detailed supporting analyses.	The review process for the early ESP plants and the issuance of RG 1.208 has greatly improved the understanding of how the probabilistic seismic hazard analyses must be performed and presented in the SSAR.

Table 3. Lessons Learned		
No.	**Background/Description**	**Lessons Learned**
2-6	Regulatory Guide 1.165 guidance is general and was implemented for an ESP application for the first time.	Several generic issues arose including that the regulatory guide anticipates that the EPRI and/or LLNL PSHA analyses will be updated about every 10 years. It has now been twenty years since these studies were performed. The ways identified within the regulatory guide to incorporate significant revision of geologic, tectonic, and seismic model parameters affecting many sites are difficult to implement for a single site.
2-7	For central and eastern U.S. (CEUS) hard rock sites, the evaluation methodology of Regulatory Guide 1.165 or Regulatory Guide 1.208 leads to high-frequency SSE amplitudes. These high frequency amplitudes are relatively high compared to: (1) lower frequency amplitudes for standard design response spectrum of existing nuclear power plants, and (2) in an absolute sense, the amplitudes predicted by design response spectra of standard shape and anchored to industry-accepted values for a PGA of 0.3g, thought to envelope SSE spectra for the majority of CEUS sites.	The evaluation of high frequency SSE spectra and comparison to standard plant design spectra remains an unresolved industry/NRC issue.
2-8	NUREG/CR-6728 guidance was implemented for an ESP application for the first time.	Although NUREG/CR-6728 provides recent advances in methods to select time histories, incorporate site-specific soil/rock column amplification factors, and compute ratios of vertical to horizontal motions at a site, acceptance by the NRC of the NUREG's methods is not assured and detailed application of its methods required first-of-kind analyses extending beyond the NUREG or any referencable literature, guidance, or precedent. Some of these issues have been resolved at the ESP level for this site.
2-9	For the evaluation of site tornado frequency, existing NRC regulatory guidance does not specify the size of the area to be used for collecting historical data. A one-degree square (one degree latitude by one degree	In the North Anna ESP application, a one-degree square was initially used for the evaluation of the tornado frequency at the site. It just so happened that the number of tornadoes that have historically been recorded in that particular one-degree square is

Table 3. Lessons Learned		
No.	**Background/Description**	**Lessons Learned**
	longitude) is very often used for such evaluations, but it may not be adequate. Care should be taken to ensure that there is enough data (i.e., that there have been a sufficient number of tornadoes in that area over time) to support a statistical evaluation. Additionally, care should be taken that the selection of the sample area does not artificially exclude severe tornadoes and thus skew the data toward less severe tornadoes.	very small. In addition, within the one-degree square there were no recorded instances of tornadoes classified as F4 (a measure of the severity of the tornado based on wind speed). However, just outside the one-degree square, F4 tornadoes have been observed. By increasing the size of the sample area from a one-degree square to a two-degree square in a subsequent revision, the nearby F4 tornadoes were appropriately included in the count and the number of events recorded over time was sufficient to support a meaningful statistical evaluation.
2-10	Seasonal and long-term variations in groundwater levels and gradient. Twelve months of field data were originally planned to be collected to determine seasonal and long-term variations in groundwater levels and gradient. The NRC Staff required that three additional months of data be collected for the site which had experienced recent severe drought conditions.	A minimum of five consecutive quarterly measurements of groundwater levels in site observation wells is needed. Comparisons should be made of fluctuations in seasonal levels with fluctuations in long-term levels measured in pre-existing site or regional observation wells. The range in groundwater gradient based on seasonal (and long-term if applicable) groundwater level measurements must be determined. Vertical hydraulic gradient measurements at the site and effect on groundwater movement must be described.
2-11	The ESP application originally took the approach to use existing meteorological data that was included in the License Renewal Application for North Anna. An update of the license renewal data set was not prepared.	The NRC did not accept this approach and required that site characteristics for meteorological data be based on an updated data set.
2-12	The site suitability evaluation with respect to radionuclide transport characteristic as defined by 10 CFR Part 100.20(c)(3) requires the use of observed site specific parameters important to hydrological radionuclide transport (such as soil, sediment, and rock characteristics, adsorption and retention coefficients, ground water velocity, and distances to the nearest surface body of water) obtained from on-site measurements. Onsite measured values of adsorption and retention coefficients for radioactive materials were not provided in the ESP application, because the	For the North Anna ESP, resolution of the SER Open Item could have required Dominion to send soil samples to a laboratory to measure adsorption coefficients. This testing would have been unplanned and would have delayed the NRC review. This issue was ultimately resolved by the NRC identifying a Permit Condition which mandates no accidental radwaste releases to the environment. For future ESP applications, unless the new unit radwaste facilities are equipped with features to preclude any and all accidental releases of radionuclides into any potential liquid groundwater

Table 3. Lessons Learned		
No.	**Background/Description**	**Lessons Learned**
	assessment of accidental releases of liquid effluents to groundwater was deferred to the COL stage when radionuclide inventories would be known. The NRC identified this issue as an SER Open Item.	pathway, site-specific distribution coefficients (Kds) should be determined using representative soil samples for the radionuclides expected to be present in liquid effluents.
2-13	Demographic projections must be made for a full 40-year period beyond the latest date the ESP unit could start operation.	As an example, assume an ESP is granted in 2010. The permit would be valid to 2030. Then add 40 years and project demographics to 2070.
2-14	Section 4 of Regulatory Guide 4.7 (Revision 2) states that preferably a reactor would be located so that, at time of initial site approval and within about 5 years thereafter, the population density, including weighted transient population, averaged over a radial distance out to 20 miles, does not exceed 500 persons per square mile. Section 3.1.3 of NUREG -0800 states that if the population density, including weighted transient population, projected at the time of initial operation exceed 500 persons per square mile averaged over any radial distance out to 30 miles, or the projected population density over the lifetime of the facility exceeds 1,000 person per square mile averaged over any radial distance out to 30 miles, a memorandum should be prepared advising appropriate staff personnel that an evaluation of alternative sites having lower population densities will be required.	It is confusing to have two different criteria existing simultaneously. The NRC should consider consolidation or provide more rationale for each criterion.
2-15	Site Suitability—obviously superior site criteria.	The NRC spent a considerable amount of resources to reach their EIS conclusion that there was no "obviously superior" site compared to North Anna. This was the subject of much of the NRC's early environmental evaluations as evidenced by their focus during the site environmental audits. The NRC visited each of the alternative sites. Dominion based much of their selection of North Anna on their DOE -funded report, "Study of Potential Sites for the Deployment of New Nuclear Plants in the United States," September 27, 2002.

Table 3. Lessons Learned

No.	Background/Description	Lessons Learned
2-16	For some subsections of SSAR Section 2.4, Hydrology, where the flooding hazards were identified as low or not contributing to the design basis flood level, the NRC Staff requested additional data on sources of information and how conclusions were reached. This included stage storage data for Lake Anna, database searches for seismic seiches and landslides, records of ice jams on upstream rivers, and documentation on the volumes of upstream reservoirs.	Even when it is obvious that a particular flood hazard will not be a factor, information and data sources need to be included in the application to substantiate the conclusions reached. If searches are made that yield no results, the sources searched should be identified with the indication that no information was found (e.g., no seiches were found in the state of Virginia after searching xyz database.)
2-17	All meteorological data reported in the ER and SSAR was based on data observed at Richmond, Virginia. This approach was consistent with the existing North Anna UFSAR. Consequently, the potential ice thickness on Lake Anna and any open water body, including the ultimate heat sink was calculated using Richmond temperature data. However, an NRC review indicated that using data from another nearby weather station northwest of the site produced a larger potential ice thickness.	Consider looking at weather data from other nearby stations when calculating ice thickness and select that which produces the maximum potential ice thickness. Resolve any questions on data sources with the NRC during pre-application interactions.
2-18	Determination of hydraulic conductivity was originally not performed with sufficient conservatism to satisfy NRC Staff reviewers.	Use conservative methods to establish a bounding hydraulic conductivity.
2-19	River meanders/diversions and hill slope failures were not addressed originally in the ESP application.	Review and discuss historical and/or geological evidence for presence of river channel meanders or diversions upstream of plant site and potential for development of future meanders or diversions that could impact site. Describe methodology used to document historical hill slope failures in the watershed. For documented hill slope failures provide a description of the failure mechanism and the hill slope properties.

Table 3. Lessons Learned		
No.	**Background/Description**	**Lessons Learned**
2-20	The NRC asked for justification for assuming that subsurface conditions were the same within an area of the ESP footprint where there were no borings as subsurface conditions in adjacent areas where borings had been made.	Unless good quality borings already exist, perform sufficient borings throughout the ESP footprint to ensure that there are no significant sizes of unexplored areas.
2-21	Since North Anna was considered a "rock site", the original work plan did not call for running SHAKE analyses in the soil at the site during the ESP stage. This approach was modified during the ESP analysis, but the SHAKE analysis used only "best estimate" values of shear wave velocity of the soil, and did not provide variation (e.g., 0.67 and 1.5 times the best-fit value). This variation was provided in response to an NRC RAI.	Even for "rock sites", perform high quality shear (and compression) wave velocity measurements in both the rock and the soil above the rock. Perform a randomization analyses to provide sufficient soil and rock parameter values to envelope possible parameter variations.
2-22	When reporting the values for extreme meteorological conditions, care should be taken that the basis for the number is clearly explained.	In the North Anna ESP evaluation of fastest mile wind speed, the value reported as a site characteristic was obtained from a design standard and it represented the 100-year return fastest mile wind for Richmond, Virginia. Elsewhere in the standard, there was another, more conservative, value that could be used for an entire segment of the United States. In addition, there was another value cited from a different source that was based on actual observation for Richmond. The latter 2 values were provided along with the first value (the site characteristic value) to serve as comparison and to help substantiate the first value. Instead of substantiating and validating the value intended to be the site characteristic, since the highest observed value for fastest mile wind speed was greater than the 100-year return value, and the basis for using the 100-year return value was not provided, the NRC questioned and later objected to the use of the 100-year return value for Richmond.

Table 3. Lessons Learned		
No.	**Background/Description**	**Lessons Learned**
2-23	The evaluation of normal liquid and gaseous radioactive waste system releases against 10 CFR 20 limits was not originally addressed in the ESP application and was deferred until the COL stage. This approach was taken because the reactor technology had not yet been selected and RS-002 did not identify the corresponding section of the SRP as being applicable. Late in the NRC's review, the NRC requested that 10 CFR 20 conformance be demonstrated by performing a bounding analysis.	Provide a bounding analysis demonstrating 10 CFR 20 conformance in the ESP application.
2-24	The original plan for cooling proposed Unit 3 was via once-through cooling using Lake Anna. Although the NRC's evaluation of once-though cooling identified small to moderate environmental impacts, state agencies expressed significant concern with once-through cooling. In response to these concerns, the basic cooling approach for Unit 3 was changed to closed-cycle cooling. This change caused a substantial delay in the ESP project schedule.	The environmental impact reviews performed by the NRC and the state agencies must be closely monitored as there is no assurance that similar conclusions will be reached.
2-25	Gaseous release X/Q analysis regulatory guidance needs options.	The NRC should clarify its guidance documents to allow for a conservative approach (e.g., no wake effects, minimum distances) or a more detailed calculation.
Part 3 – Lessons Learned for Document Production Personnel		
3-1	Technical editing was performed by one organization for the entire document.	Consider limiting the author's scope to the original draft after which time they would be required to address technical comments and verify the technical adequacy of the final product. In general, it was felt the technical editing function could have been more robust.

Table 3. Lessons Learned		
No.	**Background/Description**	**Lessons Learned**
3-2	The Writer's Guide was not issued before section authors began to write. Numerous format and consistency issues arose that caused rework and lost time during the production of the document.	The Writer's Guide evolved as the problems were identified. Future projects should have a Writer's Guide prepared and authors trained before any sections are written. The importance and time required to prepare and issue an effective Writer's Guide was underestimated.
3-3	The convention and mechanics for Reference and Figure call-outs must be clearly established before sections are written.	Considerable time and effort was expended to ensure that text reference and figure call-outs were correct. A fool-proof manual or automatic method should be established before any sections are put into production.
3-4	The final electronic format of the application is professional and easy to use.	Continue practice of preparing ESP and COL applications using the FrameMaker (or equivalent) software. Include on the project team someone who is knowledgeable in the creation of large electronic documents. This was identified as a **Best Practice**.
3-5	Video-conferencing was used as the primary method for holding Author Presentations.	This technique was found to be very effective. This method was preferred over conference telephone calls and also avoided time consuming and costly travel for face-to-face meetings. This practice or Web conferencing should be used for future ESP or COL applications.
3-6	An eRoom or ftp site was used to exchange and store large electronic files.	The use of an eRoom to exchange and store large electronic files was identified as a **Best Practice**.
Part 4 – Lessons Learned Presented by Dominion to the ACRS Subcommittee on Early Site Permits, September 6, 2006		
4-1	Seismic methodology was evolving during the course of the ESP application preparation and review.	• Support ASCE methodology for long term • Clarify SSE definition – free ground surface, foundation level • Further work needed on high frequency effects • Support continued interactions between NRC staff and NEI Seismic Issues Task Force
4-2	Plant Parameters Envelope (PPE) Concept	• Difficult concept initially • PPE provides the same level of finality as specific design

Table 3. Lessons Learned		
No.	**Background/Description**	**Lessons Learned**
		• Pare down the list of parameters to important ones
4-3	Emergency Planning	• Major features approach is a reasonable concept • Future ESP applicants should focus on minimum or full and integrated plan
4-4	Snow Load	• NRC guidance should be clarified on combination of 100 year snow load plus 24 hour winter precipitation when maximum winter season precipitation is in the form of rain
4-5	Atmospheric Diffusion Estimates, χ/Q	• Clarify guidance to allow for a conservative approach (e.g., no wake effects, minimum distance) or a more detailed calculation
4-6	Use of internet data	• NRC guidance is needed
4-7	Sources for site historical information	• Early agreement needed between NRC staff and applicant • Should occur during pre-application phase • Examples: meteorology, geology, etc.
4-8	Interactions with state and local agencies	• ESP process is new and agencies are unfamiliar with the process • Should start during pre-application phase
Part 5 – ESP Lessons Learned as Described in ACRS Correspondence, November 19, 2007		
5-1	Develop common understanding between the staff and applicants concerning expectations.	"The staff has done much to facilitate the development of common understandings. This is a most important undertaking and will continue to need attention. An incomplete understanding of staff expectations by the applicant resulted in many requests for additional information and open items in the staff's Safety Evaluation Report (SER) for the ongoing Vogtle early site permit application."

Table 3. Lessons Learned		
No.	**Background/Description**	**Lessons Learned**
5-2	Clarify the applicability of 10 CFR Part 21, "Reporting of Defects and Noncompliance," requirements for early site permit applications.	"[Recent amendment of] 10 CFR Part 52 makes it clear that 10 CFR Part 21 is applicable to early site permit applications."
5-3	Clarify the applicability of 10 CFR Part 50, Appendix B, "Quality Assurance Criteria for Nuclear Power Plants," requirements for early site permits.	"Again, [recent amendment of] 10 CFR Part 52 makes it clear that the Appendix B quality assurance requirements are applicable to early site permit applicants."
5-4	Develop improved guidance on electronic submission of applications.	"The staff has improved and clarified the process for electronic submission of applications. This has included documentation and even video clips of the process. However, additional progress can still be made in this area.
5-5	Incorporate into staff guidance definitions of terms such as "License Conditions" and "COL action items."	"The staff has incorporated these definitions into the Standard Review Plan and has trained reviewers regarding the definition.
5-6	Develop guidance for the review of performance-based methodology for assessing seismic hazards.	"The staff has issued Regulatory Guide 1.208, 'A Performance-Based Approach to Define the Site-Specific Earthquake Ground Motion.'"
5-7	Review the development and study of long-term weather cycles for periods of up to 100 years.	"The staff has made appropriate modifications to the Standard Review Plan to recognize that there are cycles in the weather. Such cycles are especially well known for the east coast of the United States. The staff has made contact with knowledgeable technical societies, will be attending pertinent scientific conferences, and is proposing research studies of trends in the frequencies and intensities of hurricanes."
5-8	Update guidance for the review of site hydrology.	"The staff has updated the Standard Review Plan. It is updating its regulatory guide on analysis of flooding. The staff is also investigating possible threats to coastal nuclear plants posed by tsunamis including tsunamis that might come from submarine landslides in the Cape Verde islands."
5-9	Develop guidance for the treatment of the high frequency component of seismic ground motion.	"The staff has provided guidance in both the Standard Review Plan and in Regulatory Guide 1.208."

Table 3. Lessons Learned		
No.	**Background/Description**	**Lessons Learned**
5-10	Develop guidance on the use of Internet data.	"The staff has not taken action on our recommendation that they develop guidance to ensure that data obtained from the Internet are valid now and retrievable in the future…"

Table 4. Benefits of the North Anna ESP

Benefit of an ESP	Dominion Experience
Determine potential suitability of the site.	The general suitability of the North Anna site was determined during the site evaluation phase of the project which preceded the ESP work. The ESP preparation process determined that no site characteristics were "show stoppers" for site development before considerable resources were expended to develop a technology-specific design.
Early resolution of siting issues.	The ESP review phase and consultations with state agencies brought to light concerns with the initial planned approach of once-through cooling for Unit 3. Thus, the ESP process served the purpose of identifying and resolving a significant concern at an early stage of Dominion's planning for Unit 3. The effect on Dominion's cost and schedule could have been more severe had this conceptual design change been made during the COL process.
Defer technology decision until justified by the business case.	The North Anna ESP application was prepared and approved using a PPE approach which allowed Dominion to select a reactor technology later.
Keep nuclear option open while monitoring and evaluating market conditions.	Although this is a benefit of the ESP process, Dominion moved directly from the ESP phase into the COL phase after having selected the ESBWR reactor technology. Market conditions and other factors led Dominion to not "bank" the ESP, but rather move directly to the COL stage.

Table 5. Table of Contents for an Early Site Permit Application	
Section	**Title**
—	**TRANSMITTAL LETTER**
PART 1	**GENERAL AND ADMINISTRATIVE INFORMATION**
PART 2	**SITE SAFETY ANALYSIS REPORT**
Chapter 1	Introduction and General Description
Chapter 2	Site Characteristics
2.1	Geography and Demography
2.2	Nearby Industrial, Transportation, and Military Facilities
2.3	Meteorology
2.4	Hydrology
2.5	Geology, Seismology, and Geotechnical Engineering
Chapter 3	Design of Structures, Systems, Components, and Equipment
Chapter 11	Radioactive Waste Management
Chapter 12	Radiation Protection
Chapter 13	Conduct of Operations
Chapter 15	Accident Analyses
Chapter 17	Quality Assurance
PART 3	**ENVIRONMENTAL REPORT**
Chapter 1	Introduction
Chapter 2	Environmental Description
Chapter 3	Plant Description
Chapter 4	Environmental Impacts of Construction
Chapter 5	Environmental Impacts of Station Operation
Chapter 6	Environmental Measurements and Monitoring Programs
Chapter 7	Environmental Impacts of Postulated Accidents Involving Radioactive Materials
Chapter 8	Need for Power
Chapter 9	Alternatives to the Proposed Action
Chapter 10	Environmental Consequences of the Proposed Action
PART 4	**PROGRAMS AND PLANS**
—	Emergency Plan
—	LWA Request/Site Redress Plan

Table 6. Pre-Section Briefings	
Subject	**Discussion Topics**
1. Approach to Section Preparation	Describe the overall approach to section preparation.
2. Conformance With NRC Regulations and Guidance	Describe conformance with applicable NRC regulations and guidance documents (10 CFR 52, Regulatory Guide 1.206, RS-002, NUREG-0800, NUREG-1555, Other Regulatory Guides, Other NUREGs, Other documents).
3. Changes/Deviations to R-COLA or DCD (this line item is applicable to a COLA FSAR only)	Identify any potential changes/deviations from the R-COLA or DCD content.
4. COL Items and ESP Permit Conditions (this line item is applicable to a COLA FSAR only)	Describe the approach, necessary actions, etc. to address each COL item and ESP Permit Condition (if applicable).
5. Links to Other Sections	Identify links to other application sections.
6. Basis/Input Documents to Be Used	Identify documents that are planned to be used as input to the section or supporting analyses and their validity.
7. Lessons Learned from Other ESP Applications and COLAs	Identify pertinent lessons learned from other ESPAs and COLAs and how addressed.
8. NRC RAIs and Questions Pertinent to the Section(s)	Describe pertinent NRC RAIs and questions from other ESPAs and COLAs and how addressed.
9. Data Collection	Describe plans for data collection and identify planned requests for information.
10. Analyses and Validation Package	Describe planned analyses, describe approach to validation package.
11. Special Challenges/Other Issues	Identify any special challenges or other issues.

This table could be used for pre-section briefings for the preparation of an ESP or COL application; items 3 and 4 would not apply to an ESP application.

Table 7. Supporting Engineering and Analyses for ESP Applications
Mechanical
Siting Study/Report
Water Balance Calculation
Chemical Feed for Raw Water and Cooling Towers
Raw Water/Station Water Pump Calculation
Waste Water Characterization Calculation
Circulating Water Optimization Study/Calculation
Circulating Water Cooling Tower Sizing Calculation
Service Water Pump Calculation
Service Water Cooling Tower Calculation
Water Use Diagram
Raw Water/Station Water Simplified P&ID/ESPA figure
Circulating Water Simplified P&ID/ESPA figure
Service Water Simplified P&ID/ESPA Figure
Potable Water/Sanitary Waste Simplified P&ID/ESPA figure
Fire Protection Yard Loop Simplified P&ID/ESPA figure
Electrical and Switchyard
Switchyard Single Line Diagram(s)
Switchyard General Arrangement Drawing(s)
Transmission Line Diagram(s)
Civil/Plant Design
Plot Plan
Boring Plan(s)
Site Plan
Construction Facilities/Site Utilization Plan
Site Topography - Rough Grade – Cut/Fill Plan
Preliminary Site Grade to Support Probable Maximum Precipitation (PMP) Calculations
Nuclear Island Excavation Plan
Various Figures to Support ESPA Chapters

Table 7. Supporting Engineering and Analyses for ESP Applications
Nuclear Analysis
Design Basis Accident Dose Analysis
Liquid and Gaseous Effluent Dose Analysis
Construction Worker Dose Analysis
Liquid Tank Rupture Activity Release Analysis
Environmental
Entrainment/Impingement Calculation
Population Distribution Projection Analysis
On-site Chemical Hazard Calculation - Explosion, Flammable Vapor Cloud, Toxic Chemicals
Nearby (Offsite) Chemical Hazard Calculation - Explosion, Flammable Vapor Cloud, Toxic Chemicals
Road Hazard Calculation - Explosion, Flammable Vapor Cloud, Toxic Chemicals
Railway Hazard Calculation - Explosion, Flammable Vapor Cloud, Toxic Chemicals
Waterway Hazard Calculation - Explosion, Flammable Vapor Cloud, Toxic Chemicals
Pipeline Hazard Calculation - Explosion, Flammable Vapor Cloud, Toxic Chemicals
Aircraft Accident Analysis
Baseline Weather Calculation
Monthly, Seasonal, Annual Mixing Heights, Wind Speed, & Ventilation Indices Analysis
Tornado Frequency Analysis
Severe Weather Calculation
Wind Rose Tabulations
Accident (Short Term) χ/Q Analysis
Normal Release (Long Term) χ/Q & D/Q Analysis
Control Room χ/Q Analysis
Technical Support Center χ/Q Analysis
Validation of Meteorological Data from Onsite Meteorological Tower
Compilation of Hourly Meteorological Data for Submittal to NRC
Evaluation of Long-Term Climatic Trends
Seasonal and Annual Cooling Tower Impact Evaluation of Fogging, Icing, Salt Deposition, and Visible Plume
Geotechnical & Hydrological Engineering
Hydrograph Validation
PMP Analysis
Probable Maximum Flood (PMF) Analysis
GIS Data Analysis in Support of Hydrologic Calculations

Table 7. Supporting Engineering and Analyses for ESP Applications
Dam Break Flooding Analysis
Wave Height and Run-up Analysis
Low Water Temperatures, Ice Thickness, and Ice Effects Analysis
Low Water Analysis
Site Drainage Analysis
Circulating Water Intake Temperature Percentiles
Circulating Water Discharge Outfall Sizing
Circulating Water Intake Structure Hydraulic Design
Circulating Water Blowdown Discharge Structure Hydraulic Design
Circulating Water Makeup Water Pipeline Hydraulic Analysis
Circulating Water Pump Intake Sizing/Hydraulic Design
Circulating Water System Steady State Analysis
Circulating Water System Transient Analysis
Subsurface Hydrostatic Loading
Contaminant Transport
Update EPRI (1988) Seismicity Catalog
Develop Procedure for Converting Between Moment Magnitude and Wave Magnitude
Shear Wave Velocity of Soil and Bedrock
Develop Rock Response Spectra
Develop Frequency Rock Spectrum Compatible Time Histories
Develop Hi and Low Frequency Target Spectra for Spectral Matching
Select Seed Input Time Histories for Spectral Matching
Develop Spectrum-Compatible Time Histories for Rock Sensitivity Analysis
Develop Spectrum-Compatible Time Histories for Site Response Analysis
Rock Column Sensitivity Analysis
Develop Amplification Factors and Sigmas as a Function of Rock Input Motion
Develop Method 2A ASCE FOSID Response Spectra
Develop Vertical SSE from Horizontal SSE
Site Response Analyses of Randomized Rock Profiles
Develop SSE Spectrum
Tabulation of Seismic Source Data
Surface Faulting Field Reconnaissance Report
Source Logic for EPRI-SOG Sources

Table 7. Supporting Engineering and Analyses for ESP Applications
Develop Updated Rock Seismic Hazard
Replication of 1989 EPRI-SOG Hazard
Develop Geotechnical Engineering Properties and Subsurface Materials
Liquefaction Analysis
Bearing Capacity and Settlement Analyses
Lateral Earth Pressures on Building Structures Analysis
Emergency Planning
Evacuation Time Estimate Analysis