UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

BEFORE THE ATOMIC SAFETY AND LICENSING BOARD

In the Matter of	)	
	)	
DOMINION NUCLEAR NORTH ANNA, LLC	)	Docket No. 52-008-ESP
	)	
(Early Site Permit for North Anna ESP Site)	)	

NRC STAFF'S PROPOSED FINDINGS OF FACT AND CONCLUSIONS OF LAW IN THE MANDATORY HEARING

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I. INTRODUCTION

1.1. These findings and rulings address all uncontested issues with respect to the application filed by Dominion Nuclear North Anna, Inc. ("Dominion" or the "Applicant") for an early site permit ("ESP") for the North Anna ESP site in Mineral, Virginia, under 10 C.F.R. Part 52, Appendix A.

1.2. These findings are made in association with the mandatory hearing required by Section 189a.(1)(A) of the Atomic Energy Act of 1954, as amended ("AEA"). 42 U.S.C. § 2239. The two contentions admitted during the contested portion of the proceeding were the subject of previous rulings by this Atomic Safety and Licensing Board ("Board"). *Dominion Nuclear North Anna, LLC* (Early Site Permit for North Anna ESP Site), unpublished Order (Approving Settlement and Dismissal of Contention EC 3.3.4), January 6, 2005; *Dominion Nuclear North Anna, LLC* (Early Site Permit for North Anna ESP Site), LBP-06-24, 64 NRC 360 (2006).

1.3 For the reasons stated below, the Board makes the following findings of fact and conclusions of law.

II. PROCEDURAL BACKGROUND

2.1 On September 23, 2003, Dominion filed an application pursuant to Subpart A of 10 C.F.R. Part 52 for an ESP. The application requested that the NRC approve a site within the existing North Anna Power Station boundaries, near Lake Anna in Louisa County, Virginia, as

suitable for the construction and operation of one or more nuclear power generating facilities, and issue an ESP for the proposed site. *See* Staff Ex.1, p. 1-1. The Commission published a notice of hearing and opportunity to petition for leave to intervene in the *Federal Register* on December 2, 2003. Dominion Nuclear North Anna, LLC; Notice of Hearing and Opportunity to Petition for Leave to Intervene; Early Site Permit for the North Anna ESP Site, 68 Fed. Reg. 67,489 (Dec. 2, 2003) ("Notice of Hearing").

2.2 As set forth in the Notice of Hearing, the Commission directed the Board to conduct a hearing in accordance with 10 C.F.R. Part 2, and to make certain findings required by 10 C.F.R. § 2.104(b), discussed further below.

2.3 On January 2, 2004, the Blue Ridge Environmental Defense League, Nuclear Information and Resource Service, and Public Citizen (collectively, the "Intervenors") filed a hearing request and petition to intervene pursuant to then-applicable 10 C.F.R. § 2.714,[1] followed by a statement of proposed contentions on May 3, 2004.

2.4 On March 22, 2004, a Board was established to rule on petitions for hearing and leave to intervene, and to preside over the adjudicatory proceeding held in connection with the North Anna ESP application. Dominion Nuclear North Anna, LLC; Establishment of Atomic Safety and Licensing Board, 69 Fed. Reg. 15,910 (Mar. 26, 2004). Thereafter, on August 6, 2004, the Chief Administrative Judge reconstituted the Board and appointed the current panel. Dominion Nuclear North Anna, LLC (ESP for North Anna ESP Site); Notice of Reconstitution, 69 Fed. Reg. 49,916 (Aug. 12, 2004).

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[1] Following a motion from the Applicant to apply the then-newly promulgated hearing procedures, which became effective on February 13, 2004, the Commission directed that this proceeding, as well as two other then-pending ESP proceedings, be conducted under the "new rules." *See Dominion Nuclear North Anna, LLC* (Early Site Permit for North Anna ESP Site), *Exelon Generation Co., LLC* (Early Site Permit for Clinton ESP Site), *System Energy Resources, Inc.* (Early Site Permit for Grand Gulf ESP Site); CLI-04-8, 59 NRC 113 (2004).

2.5 The Board admitted two contentions, EC 3.3.2, regarding impacts on striped bass in Lake Anna, and EC 3.3.4, regarding the Environmental Report's ("ER") failure to address the no-action alternative. *Dominion Nuclear North Anna, LLC* (Early Site Permit for North Anna ESP Site), LBP-04-18, 60 NRC 253 (2004). Ultimately, EC 3.3.4 was settled by the parties, and EC 3.3.2 was resolved via summary disposition. *See Dominion Nuclear North Anna, LLC* (Early Site Permit for North Anna ESP Site), unpublished Order (Approving Settlement and Dismissal of Contention EC 3.3.4), January 6, 2005; *Dominion Nuclear North Anna, LLC* (Early Site Permit for North Anna ESP Site), LBP-06-24, 64 NRC 360 (2006).

2.6 As indicated in the Notice of Hearing, the U.S. Nuclear Regulatory Commission staff (the "Staff") has completed a detailed technical review of the application, and has documented its findings in a final Safety Evaluation Report ("FSER") and a final Environmental Impact Statement ("FEIS"). *See* NUREG-1835, "Safety Evaluation Report for an Early Site Permit (ESP) at the North Anna ESP Site" (September 2005) (Staff Ex. 1); NUREG-1811, "Environmental Impact Statement for an Early Site Permit (ESP) at the North Anna ESP Site" (December 2006) (Staff Ex. 3). Following completion of the Staff's FSER, Dominion submitted Revision 6 to its application, in which it proposed to (1) change its approach for cooling Unit 3 from a once-through system to a closed-cycle, combination wet and dry cooling system; and (2) increase the maximum power output per unit from 4300 MW(t) to 4500 MW(t) for Units 3 and 4. *See* NUREG-1835, Supplement 1, "Safety Evaluation Report for an Early Site Permit (ESP) at the North Anna Site" (November 2006) ("FSER Supplement"), at 1-2 (Staff Ex. 2). Additional information regarding these changes was provided in Revisions 7 and 8 of the application and in Revision 9, Dominion proposed to reduce the bounding value for tritium activity release. Staff. Ex. 2, p. 1-2. The Staff issued the FSER Supplement to evaluate these changes.

2.7 In preparation for the uncontested portion of the hearing, this Board reviewed the application, and the Staff's aforementioned review documents. Based on this review, the Board

asked the Staff and Dominion to respond to two separate rounds of written questions, relating to both safety and environmental issues. *See Dominion Nuclear North Anna, LLC* (Early Site Permit for North Anna ESP Site), unpublished Order (Issuing Safety-Related Questions) (Jan. 18, 2007); *Dominion Nuclear North Anna, LLC* (Early Site Permit for North Anna ESP Site), unpublished Order (issuing Environment-Related Questions) (Feb. 7, 2007).

2.8 The Board's safety and environmental questions addressed both technical and legal matters, and, pursuant to the Board's instruction, the Staff submitted its responses to the technical questions in exhibit form, under oath or affirmation. *See* NRC Staff Legal Brief in Response to Licensing Board's Safety-Related Questions, dated February 8, 2007;[2] NRC Staff Legal Brief in Response to Licensing Board's Environment-Related Questions, dated March 1, 2007;[3] NRC Staff Legal Memorandum Transmitting the Staff Response to Board Environment-Related Question 2, dated March 7, 2007.[4]

2.9 In its March 20, 2007 Order, this Board set seven hearing topics to be addressed in the evidentiary hearing, as follows:

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[2] The Staff's Responses to the Board's Safety Questions are Staff Exhibit 6; the Attachment to the NRC Staff's Response to Board Safety Question 86 is Staff Exhibit 7; the Attachment to the NRC Staff's Response to Board Safety Question 90 is Staff Exhibit 8; and the Staff's Affidavits and Statements of Professional Qualifications supporting its Responses to the Board's Safety Questions are Staff Exhibit 9.

[3] The Staff's Responses to the Board's Environmental Questions are in Staff Exhibit 10; and the Staff's Affidavits and Statements of Professional Qualifications supporting its Responses to the Board's Environmental Questions are in Staff Exhibit 11.

[4] On February 20, 2007, the Staff requested reconsideration and clarification of Board Environmental Question 2; the Board granted the Staff's motion and directed the parties to answer the Board Question in accordance with the clarification requested by the Staff. *See Dominion Nuclear North Anna, LLC* (Early Site Permit for North Anna ESP Site), unpublished Order (Reconsideration of Two Environmental Questions and Grant of Extension). The Staff's Response to Board Question 2 is Staff Exhibit 12; the Staff's Affidavits supporting its Response are in Staff Exhibit 13.

(1) Site Characterization – Hydrology, Soil, Vadose Zone, Groundwater, and Aquifers. Each party shall designate and produce a subject matter expert or experts to provide the Board with a brief presentation and to respond to questions concerning the measurement, monitoring, data, and characterization of the hydrology of, and any radiological or chemical contamination in, the soil, vadose zone, groundwater, and aquifers at or near, the proposed site.

(2) Tritium. Each party shall designate and produce a subject matter expert or experts to provide the Board with a brief presentation and to respond to questions concerning the sources, release mechanisms, approximate contributions, pathways, and concentrations of tritium associated with nuclear power reactors in general and associated with the NAPS [North Anna Power Station] and ESP sites in particular. This should include such information about tritium in general, the tritium currently existing and emanating from the proposed site, the nature, extent and strata of tritium in and concentrating in the site, the lake, and the environment, and the various sources, levels, and vectors of tritium associated with each of the seven types of reactors proposed by Dominion.

(3) Zero Release Commitment. The Staff shall designate and produce a subject matter expert or experts to respond to questions concerning the Staff's proposed ESP permit condition 4 "requiring that an applicant referencing any such ESP design any new unit's radwaste systems to preclude any and all accidental releases of radionuclides into any potential liquid pathways" and the Staff's associated determination to exclude any such releases in assessing the potential environmental impact of the proposed ESP.

(4) Radiological Releases and Doses from Normal Operations. Each party shall designate and produce a subject matter expert or experts to provide the Board with a brief presentation and to respond to questions concerning radiological releases, pathways, and doses associated with the existing site and the proposed ESP, including the nature, adequacy, and confidence levels associated with the data, estimates, and calculations, the monitoring and measurements performed or to be imposed to assure compliance, and the relevant regulatory standards.

(5) Surface Water Impacts and Possible Mitigation Measures. Each party shall designate and produce a subject matter expert or experts to provide the Board with a brief presentation and to respond to questions concerning the potential impacts (*e.g.*, lake levels, altered downstream flows, etc.) of the proposed ESP on the water in Lake Anna and downstream, studies performed or imminent (*e.g.*, the IFIM), and possible measures to mitigate these impacts.

(6) Seismic Safety. Each party shall designate and produce a subject matter expert or experts to provide the Board with a presentation and respond to questions concerning the geology and seismology of the proposed ESP site and nature, adequacy, and confidence levels associated with the data and the standards used by the Staff to assess the seismic safety of the proposal.

(7) NEPA [National Environmental Policy Act] Alternatives. The Staff shall designate and produce a subject matter expert or experts to respond to questions concerning the Staff's identification consideration [sic] of all reasonable alternatives including system design alternatives, alternative sites, and other alternatives and possible mitigation measures.[5]

In addition, the Board directed the parties to submit prefiled materials consisting of written statements of position, written testimony, and supporting exhibits; and posed three additional questions to the parties. *Dominion Nuclear North Anna, LLC* (Early Site Permit for North Anna ESP Site), unpublished Order (Instructions for Submission of Written Materials and Setting of Topics and Procedures for Evidentiary Hearing), March 20, 2007.

2.10 Pursuant to the Board's Order of March 20, 2007, the Staff filed the "NRC Staff's Written Statement of Position," which addressed the six mandatory findings that the Board must make in order to issue an ESP after an uncontested proceeding. NRC Staff's Written Statement of Position, dated April 10, 2007 ("Written Statement"). In its Written Statement, the Staff addressed the six fundamental hearing issues. That discussion of the six fundamental issues is incorporated herein by reference, and is further augmented by the findings of fact set forth below in Section IV.

2.11 This Board held an evidentiary hearing ("Evidentiary Hearing") on the uncontested portion of the application, including the matters identified in the Board's safety and environmental questions, as well as the seven hearing topics identified in the Board's March 20, 2007 Order, in Louisa, Virginia, on April 24, 25, and 26, 2007. Witnesses identified by the Staff (for all seven hearing topics) and Dominion (for all hearing topics except the Zero-Release

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[5] In its April 18, 2007 prehearing conference, the Board determined that these seven hearing issues would be addressed in a different order than that listed in the March 20 Order. The proposed findings of fact set forth in Section IV, *infra*, discuss the seven hearing issues in the order that they were addressed at the Evidentiary Hearing. Tr. 603:5.

Commitment and National Environmental Policy Act ("NEPA") Alternatives) also provided testimony at the evidentiary hearings.

2.12 These proposed findings of fact and conclusions of law set forth the Board's findings of fact with respect to the evidence in the record and the testimony presented at the Evidentiary Hearing concerning the uncontested portions of the application, as well as the Board's conclusions of law with respect thereto.

III. LEGAL STANDARDS AND REGULATORY GUIDANCE

A. Legal Standards

3.1 For an early site permit, which is considered a partial construction permit, the NRC must hold a hearing whether or not the issuance of the application is contested. AEA Section 189a., 42 U.S.C. § 2239(a); *see* 10 C.F.R. § 52.21. These types of hearings are known as "uncontested" or mandatory hearings. This is in contrast to a "contested" hearing, which will take place if "(1) there is a controversy between the NRC Staff and the applicant concerning the issuance of a license or any of the terms thereof, or (2) a petition for leave to intervene in opposition to the application has been granted or is pending before the Commission." 10 C.F.R. § 2.4. If a license application for a facility subject to the mandatory hearing requirement is contested, then the hearing will be bifurcated into contested and uncontested portions on an issue-by-issue basis. *Exelon Generation Co.*, *LLC* (Early Site Permit for Clinton ESP Site), CLI-05-17, 62 NRC 5, 34-35 (2005).

3.2 For hearings on uncontested applications, such as this one (or on uncontested portions or otherwise contested applications, the Board, pursuant to 10 C.F.R. § 2.104(b)(2), must consider the following:

> (i) Without conducting a *de novo* evaluation of the application, whether the application and the record of the proceeding contain sufficient information, and the review of the application by the Commission's staff has been adequate to support affirmative findings on (b)(1)(i) through (iii) specified in [10 C.F.R. § 2.104] and a negative finding on (b)(1)(iv) specified in [10 C.F.R. § 2.104]

> proposed to be made and the issuance of the construction permit proposed by the Director of Nuclear Reactor Regulation, . . . , and
> (ii) If the application is for a construction permit for a nuclear power reactor . . . whether the review conducted by the Commission pursuant to the National Environmental Policy Act (NEPA) has been adequate.

The instructions in the Commission's Notice of Hearing for this proceeding are consistent with these considerations. Notice of Hearing, 68 Fed. Reg. at 67,489.

3.3 In addition, pursuant to 10 C.F.R. § 51.105(a), the Board must make the following determinations regarding NEPA issues:

> (1) Determine whether the requirements of section 102(2)(A), (C) and (E) of [NEPA] and the regulations in [10 C.F.R. Part 51, Subpart A] have been met;
>
> (2) Independently consider the final balance among conflicting factors contained in the record of the proceeding with a view to determining the appropriate action to be taken; and
>
> (3) Determine, after weighing the environmental, economic, technical, and other benefits against environmental and other costs, and considering reasonable alternatives, whether the construction permit . . . should be issued, denied, or appropriately conditioned to protect environmental values.

3.4 On July 28, 2005, the Commission issued a Memorandum and Order responding to six questions certified by the Atomic Safety and Licensing Board Panel concerning the NRC's statutory duty to conduct a "mandatory" (or uncontested) hearing for certain license applications. *Clinton*, CLI-05-17, 62 NRC 5. Among the certified questions was whether, in uncontested hearings, the Board should conduct a *de novo* review of the license application, or whether the Board should instead determine only whether the Staff's review of the application was sufficient. The Commission determined that a *de novo* review is not necessary for mandatory hearings. Rather:

> [W]hen considering safety and environmental matters not subject to the adversarial process – so-called "uncontested" issues – the boards should decide simply whether the safety and environmental record is "sufficient" to support license issuance. In other words, the boards should inquire whether the NRC Staff performed an adequate review and made findings with reasonable support in logic and fact.

Id. at 39. With respect to NEPA considerations, the Commission stated that "licensing boards must reach their own independent determination on uncontested NEPA 'baseline' questions – *i.e.*, whether the NEPA process 'has been complied with,' what is the appropriate 'final balance among conflicting factors,' and whether the 'construction permit should be issued, denied, or appropriately conditioned.'" *Id.* at 45 [citations omitted].

B. NRC Regulatory Guidance

3.5 The NRC Staff's FSER delineates the scope of technical matters the Staff considered in evaluating the ESP application and the suitability of the proposed site. NRC Review Standard ("RS")-002, "Processing Applications for Early Site Permits," issued in May 2004 (Staff Ex. 14), provides detail concerning the scope and bases of the Staff's review of the radiological safety and emergency planning aspects of a proposed nuclear power plant site. FSER, Staff Ex. 1, p. 1-2. Prepared specifically to address the evaluation of ESPs, this review standard contains regulatory guidance derived from NUREG-0800, Revision 3, "Standard Review Plan for the Review of Safety Analysis Reports for Nuclear Power Plants," issued in July 1981 (hereinafter referred to as the "Standard Review Plan" or "SRP"). Staff Ex. 1, p. 1-2. The SRP reflects the NRC Staff's historical experience in establishing and promulgating guidance concerning the safety of nuclear facilities, as well as in evaluating safety assessments. Staff Ex. 1, p. 1-2. Selected topics in the SRP are not within the scope of an ESP review, or addressed in this ESP proceeding. Those topics will be addressed, as appropriate and applicable, in other regulatory actions (for example, in the context of a combined license application) in connection with a reactor or reactors that might be constructed on the North Anna ESP site. Staff Ex. 1, p. 1-2. The format of the SER is essentially consistent with that of the SRP.

3.6 Similarly, guidance for the Staff's consideration of environmental matters in the ESP application is provided in RS-002. With respect to the environmental review, the review standard also draws from NUREG-1555, "Standard Review Plans for Environmental Reviews for Nuclear Power Plants," issued in October 1999 ("ESRP"). Staff Ex. 3, p. 1-4. As stated in RS-002, an applicant may elect to use a plant parameter envelope ("PPE") approach instead of supplying specific design information. The NRC specifically adapted the ESRP guidance to the PPE concept. Staff Ex. 3 at 1-4. In addition, the staff also considered the information and analyses provided in NUREG-1437, "Generic Environmental Impact Statement for License Renewal of Nuclear Plants ("GEIS"), issued in May 1996 in its review. Because the GEIS included a review of data from all operating nuclear power plants, the Staff found some of the information useful for the environmental review of the proposed action. Staff Ex. 3, p. 1-4.

IV. FINDINGS OF FACT

A. Hearing Topic 1, "Surface Water Impacts and Possible Mitigation Measures"

4.1 The Board considered Hearing Topic 1, Surface Water Impacts and Possible Mitigation Measures, at the Evidentiary Hearing. The Board accepted the Staff's presentation on this issue and examined the Staff's witnesses to determine that the Staff has sufficiently examined this topic to support the findings below.

4.2 The testimony addressed the choice of the type of cooling system for each new unit that might be built on the North Anna ESP site, effects on aquatic ecology in the lake and downstream of the North Anna Dam, effects on lake level, mitigation measures, and socioeconomics.

4.3 A fourth unit at the North Anna ESP site would employ dry cooling, which would eliminate detectable water impacts from that unit. Tr. 68:22. The Staff evaluated water use for the fourth unit based on the cumulative effect of a third unit and a fourth unit at the North Anna ESP site. Tr. 585:19. While designs other than dry cooling were considered for a fourth unit,

the presence of Unit 3 made those other options unacceptable. Tr. 585:13. Accordingly, the Staff proposed Permit Condition 3.E.(2), which would require that a fourth unit employ dry cooling. *See* Staff Ex. 17, p.3.

4.4 A third unit ("Unit 3") at the North Anna ESP site would employ a closed cycle combined wet/dry cooling design. Tr. 68:24. This design would effectively eliminate direct thermal impacts from Unit 3 on Lake Anna. Tr. 69:1.

4.5 Operation of the proposed Unit 3 wet/dry cooling system would involve impacts from consumptive water use. Tr. 69:4. With the addition of Unit 3 the fraction of time during which 40 or more cubic feet per second flows through the dam is reduced by approximately 2 to 3 percent. Tr. 78:3. Adding Unit 3 also increases the fraction of time during which 20 cubic feet per second flows occur by approximately five percent. Tr. 78:5. The effects of the reduced flows resulting from the wet/dry cooling system are discussed below.

4.6 Lake Anna is a typical southeastern mature and managed reservoir with an excellent sport fishery. Tr. 74:17. With that understanding, the Staff assessed the impact to the reservoir biota should additional units be constructed and operated at the North Anna ESP site. Tr. 74:19.

4.7 The Staff examined potential effects related to site runoff during construction, construction and operation of the intake structure, including the impingement and entrainment of fishes, effects related to the station discharge or water quality related impacts, including thermal effects, such as heat shock and cold shock, and the impacts related to the loss of reservoir habitat in the vicinity of the site. Tr. 75:9. For the reasons set forth in the FEIS, the Staff has concluded that there will be no detectible impacts to fish populations in Lake Anna due to the construction and operation of Units 3 and 4. Tr. 75:22; Staff Ex. 3, §§ 4.4.2, 5.4.2.8.

4.8 With respect to downstream impacts, the Staff assessed impacts of Unit 3 to aquatic biota in the North Anna and the Pamunkey Rivers downstream of the North Anna Dam.

Tr. 76:14. The Staff evaluated fish, invertebrates and aquatic and riparian plants. Tr. 76:16. The Staff assessment determined that the potential stressor was flow, primarily from dam releases. Tr. 76:18.

4.9 The major spawning areas are located principally in the Pamunkey River, which originates at the confluence of the North and South Anna Rivers about 34 miles below the North Anna Dam. Tr. 79:24; Tr. 150:20. Because low flow events do not coincide with spawning periods for most of the sensitive fish species, the impacts are expected to be small. Tr. 78:20; Tr. 82:10. In addition, existing biota and plant assemblages have adapted to the existing flow regimes and are tolerant of occasional low flow conditions. Tr. 81:9; Tr. 153:14; Tr. 155:20.

4.10 The Staff considered four major mitigation measures, which are described in the following four paragraphs, in addition to the closed cycle combined wet/dry cooling system for Unit 3 adopted by Dominion. Tr. 85:6.

4.11 First, the Staff considered reducing the intake screen flow velocity to 0.5 ft/s or less. Tr. 85:19. Since impingement occurs when swimming organisms are not strong enough to escape the cooling water intake current and are caught or stuck on screens (Staff Ex. 3, p. 5-19), reducing intake screen velocity could reduce impingement losses. Staff Ex. 3, p. 5-22. Even without reducing intake screen velocity, however, Unit 3 operation with a closed-cycle combination wet and dry cooling system would increase total cooling water withdrawal from Lake Anna by approximately 1 percent, and would result in a minimal increase in impingement. Staff Ex. 3, p. 5-21. Accordingly, impacts of impingement would be small. Staff Ex. 3, p. 5-22. The Commonwealth of Virginia will address intake screen velocity during the NPDES permitting process. Tr. 85:22.

4.12 Second, the Staff considered installing traveling screen panels with a mesh size of 1 mm (fine mesh screens) to reduce entrainment. Tr. 86:16. Instead of being entrained, larvae and eggs would be impinged on the screens. Staff Ex. 3, p. 5-25. Larvae and eggs

would be impinged on these screens because they have little or no motility and cannot avoid the intake. Staff Ex. 3, p. 5-25. Larvae and eggs would still experience mortality rates of close to 100 percent. Staff Ex. 3, p. 5-25. Accordingly, the Staff concluded that use of fine mesh screens as described for mitigation of entrainment was not warranted. Staff Ex. 3, p. 5-25.

4.13 Third, the Staff considered the effect of raising the normal operating pool level of Lake Anna. Tr. 87:4. Raising the normal operating pool level ten inches would eliminate the increase in frequency of 20 cubic feet per second flows through the North Anna Dam during low water conditions resulting from Unit 3 operation. Tr. 87:7; Tr. 88:5. Raising the operating pool level would shift some wetlands and result in additional water being available downstream, particularly during low water or drought conditions. Tr. 87:9. However, modification of some private fixed structures such as docks, boat houses, and boat ramps might be necessary, since some of them do not have a lot of freeboard. Tr. 92:5; Tr. 92:21. The authority to set lake level resides with the Commonwealth of Virginia. Staff Ex. 3, p. 5-31.

4.14 Fourth, the Staff considered the effects of varying the North Anna Dam release rates during the later summer and fall to more closely emulate the natural variation and stream flow (called normative flow) typically experienced in water courses draining the southeastern United States. Tr. 88:22. Varying release rates from the North Anna Dam in this manner may be beneficial for some species. Tr. 99:25; Staff Ex. 3, p. 5-33. Additional flow studies may determine whether more normative flows would be beneficial. Tr. 111:6. The Staff has recommended Permit Condition 3.I.(2) to require the performance of such studies, in furtherance of this potential mitigation measure. Staff Ex. 17, p. 5.

4.15 With respect to socioeconomics, the Staff considered the effects of Unit 3 operation on socioeconomics. Tr. 91:11. Specifically, during normal years, the water level in Lake Anna is maintained at 250 feet, so no mud flats would be exposed and recreational activities would be at normal levels. Tr. 91:13. Accordingly, impacts to socioeconomics

resulting from changes in Lake Anna water levels due to Unit 3 operation during normal years would be small. Tr. 91:16

4.16 During severe drought, however, low water levels would be more frequent and lake levels would be lower with Unit 3 operating. Tr. 91:19. There would be moderate and temporary impacts on private lake front property views with lake water levels below 248 feet, as observed during the 2001/2002 drought. Tr. 91:23. During such conditions, there would be substantial mud flats. Tr. 92:1. Property values, however, were not observed to be adversely affected during the 2001/2002 drought. Fishing was still possible and successful in the 2001/2002 drought, so the fishing-related businesses were able to continue operating. Tr. 92:10; Tr. 92:19.

4.17 With respect to the effects of construction and operation on Lake Anna and downstream and the possible mitigation measures discussed above, this Board finds that: (1) the Staff employed a systematic, interdisciplinary approach integrating hydrology, aquatic biology, aquatic ecology, and socioeconomics in evaluating the proposed action, as required by NEPA § 102(2)(A); (2) the Staff described in detail in the FEIS the impacts of the proposed action, the adverse environmental effects of the proposed action that cannot be avoided, and alternatives to the proposed action, as required by NEPA § 102(2)(C); (3) the Staff studied, developed and described appropriate alternatives to the Staff's recommended action in accordance with NEPA § 102(2)(E); and (4) the Staff has proposed appropriate permit conditions with respect to mitigation. Accordingly, the findings set forth above in ¶¶ 4.1-4.16 augment the findings on the NEPA baseline issues set forth in the Staff's Written Statement and support this Board's conclusions that the overall balance supports issuance of the ESP, the Staff's NEPA review has been adequate, and the facts in the record support the Staff's conclusions with respect to environmental matters, which support the Staff's recommendation to issue the ESP, conditioned as discussed herein to protect environmental values.

B. Hearing Topic 2, "Site Hydrology"

4.18 The Board considered Hearing Topic 2, Site Hydrology, at the Evidentiary Hearing. The Board accepted the Staff's presentation on this issue and examined the Staff's witnesses to determine that the Staff had sufficiently examined this topic to support the findings below.

4.19 The Staff evaluated hydrology information that may affect the design and siting of a nuclear power plant in order to ensure that a nuclear power plant or plants could be designed, constructed, and operated on the proposed ESP site in compliance with the Commission's regulations. Staff Ex. 1, p. 2-58. The relevant regulatory requirements governing site hydrology information to be included in an ESP application and considered by the Staff are contained in 10 C.F.R. §§ 52.17(a) and 100.20(c). Staff Ex. 1, p. 2-60. The Staff guidance relevant to site hydrology is contained in RG 1.70 and RS-002. Id.

4.20 The hydrologic setting at the proposed site includes a layer of saprolite soil, ranging in thickness from 2 to 102 feet, which overlies bedrock. Staff Ex. 1, p. 2-129. The soil at the site also includes a vadose zone, which consists of the unsaturated zone between the free land surface and the saturated zone. Tr. 203:2. Groundwater at the site consists of an interconnected aquifer that spans both the saprolite and bedrock layers. Tr. 203:5.

4.21 Long-term settlement of plant structures in saprolite soils was identified as an issue for the existing Units 1 and 2 at the North Anna site. Settlement issues affecting structures placed on saprolite soils for any new units on the ESP site will be addressed through a permit condition precluding the ESP holder, as well as an applicant for a CP or COL referencing this ESP, from using an engineered fill with high compressibility and low maximum density, such as saprolite (proposed Permit Condition 3.E.(5)). Tr. 209:23; Staff Ex. 17, p. 3.

4.22 In addition to the permit condition discussed in the previous paragraph, the ESP will contain permit conditions requiring an applicant for a CP or COL referencing the ESP to

excavate weathered or fractured rock at the foundation level and replace it with lean concrete before the commencement of foundation construction (proposed Permit Condition 3.E.(4)); and improve Zone II saprolitic soils to reduce any liquefaction potential if safety-related structures are to be founded on them (proposed Permit Condition 3.#.(8)). Staff Ex. 17, p. 3-4.

4.23 The ESP site contains a gentle slope, with general hydrologic characteristics at the site consisting of a general gradient of 0.03 ft/ft towards Lake Anna and hydraulic conductivity of 3.4 ft/day. Tr. 205:12; Tr. 214:10.

4.24 A portion of the ESP site is elevated. The Staff questioned the stability of this elevated section of the ESP site with respect to hill slope failure and conducted a review to determine whether there was any historical evidence of slope failure into Lake Anna. No historical evidence of hill slope failure into Lake Anna was uncovered during the Staff's review. Tr. 212:18.

4.25 There is no history of chemical releases or spills at the ESP site and all potential sources of chemicals are downgradient of the ESP site. Tr. 277:24. Three significant oil spills occurred at the existing North Anna site during the life of the existing nuclear power station and all three of these spills were addressed immediately. Tr. 282: 17. There have been no chemical releases at the existing North Anna site that have exceeded the reportable quantity. Tr. 283:3.

4.26 In addition, there are two drinking water wells on the ESP site at depths of 305 and 375 feet. Water samples from these two drinking water wells were collected by the Applicant and the resulting data did not indicate any chemical contamination. Tr. 278:4. Similarly, storm water runoff from the vicinity of the ESP site was sampled by the Applicant and analyzed for the presence of chemical contaminants, including metals, chemical pesticides, and PCBs. Tr. 279:11. This storm water sampling was performed as part of a permitting program administered by the Virginia Department of Environmental Quality. Tr. 279:17. The sample

results for these storm water samples did not reveal levels of chemical contamination that were of concern to the Virginia Department of Environmental Quality. Tr. 280:21.

4.27 Having considered the above and the evidence in the record, we find that the Staff adequately examined the hydrology of the soil, vadose zone, groundwater, and aquifers at or near, the proposed site. Accordingly, with respect to these issues, taking into consideration the site criteria contained in 10 C.F.R. § 100.20(c), a reactor, or reactors, having the characteristics that fall within the parameters for the site can be constructed without undue risk to the health and safety of the public. The findings set forth above in ¶¶ 4.18 - 4.26 augment the Staff's findings on Safety Issue 2 in its Written Statement, and support this Board's affirmative finding regarding Safety Issue 2.

C. Hearing Topic 3, "Tritium"

4.28 The Board considered Hearing Topic 3, Tritium, at the Evidentiary Hearing. The Board accepted the Staff's presentation on this issue and examined the Staff's witnesses to determine that the Staff had sufficiently examined this topic to support the findings below.

4.29 The Staff has reviewed the information on radiological dose consequences caused by gaseous and liquid effluents that may be released from normal operation of the plant that was provided by reference in the Site Safety Analysis Report. Staff Ex. 2, p.11-1. Tritium is included as one of several radionuclides in both liquid and gaseous effluents. Staff Ex. 6, Response to Board Question 29.

4.30 Tritium is produced in reactors by neutron reactions with light elements in reactor coolant and by ternary fission in fuel. Tr. 298:18. The Staff examined the tritium releases expected from the different types of proposed reactors. Tr. 299:2.

4.31 The PPE consists of the outer bound of the maximum expected tritium released from the various reactor designs including Advanced Boiling Water Reactor ("ABWR") and

Economic Simplified Boiling Water Reactor ("ESBWR"). The PPE values will be examined at the CP or COL stage. Tr. 311:13.

4.32 The normal release mechanism of tritium would be through the liquid waste management system and the gaseous waste management system. Tr. 302:12.

4.33 The revised tritium source term value of 850 Ci/yr, which would result in an estimated tritium concentration of approximately 9,400 pCi/l in Lake Anna based on the continued operation of Units 1 and 2 and the addition of Units 3 and 4. The estimated contribution of tritium from Units 3 and 4 from the PPE would be 6,400 pCi/l. This level remains below the EPA safe drinking water level of 20,000 pCi/l. Tr. 312:10; Tr. 327:2; *See* Staff Exhibit 10, Response to Board Question 62. The gaseous tritium effluent source term is 3,500 Ci/yr with an additional 216 Ci/yr released to the atmosphere from the Unit 3 wet cooling towers. Tr. 312:15.

4.34 The Staff identified the normal liquid and gaseous effluent pathways of tritium. Tr. 313:1. The Staff identified that certain leaks of tritium to groundwater from the existing units were not considered as a pathway in the FEIS because of proposed Permit Condition 3.E.(3), which will require the applicant to submit a radiological waste system design with features to preclude accidental releases of radionuclides into any potential liquid pathway. Staff Ex. 10, Response to Board Question 62.a; Staff Ex. 17, p. 3.

4.35 The Staff summarized that the tritium levels from the existing Units 1 and 2 are currently below EPA drinking water standards both in the waste heat treatment facility and in Lake Anna. Tr. 315:3. The Staff concluded that radiological doses to members of the public from radioactive gaseous and liquid effluents resulting from the normal operation of one or two new nuclear power plants that might be constructed on the proposed ESP site do not present an undue risk to the health and safety of the public. Staff Ex. 2, p. 11-6.

4.36 The Staff employed a systematic, interdisciplinary approach integrating natural, environmental, and social sciences such as hydrology, aquatic biology, health physics, and meteorology, in evaluating the proposed action, as required by NEPA § 102(2)(A). The Staff described in detail in the FEIS the impacts of the proposed action, the adverse environmental effects of the proposed action that cannot be avoided, and alternatives to the proposed action, as required by NEPA § 102(2)(C). The Staff studied, developed and described appropriate alternatives to the Staff's recommended action in accordance with NEPA § 102(2)(E). Taking into consideration the site criteria contained in 10 C.F.R. Part 100, a reactor, or reactors, having the characteristics that fall within the parameters for the site can be constructed without undue risk to the health and safety of the public, thus supporting an affirmative finding on Safety Issue 2. Accordingly, the findings set forth above for this Hearing Topic augment the six mandatory findings set forth in the Staff's Written Statement of Position and support the issuance of the ESP. Having considered the above, we find that the Staff have adequately examined sources, release mechanisms, approximate contributions, pathways, and concentrations of tritium associated with the issuance of this ESP.

D. Hearing Topic 4, "Radiological Releases and Doses from Normal Operations"

4.37 The Board considered Hearing Topic 4, Radiological Doses from Normal Operations, at the Evidentiary Hearing. The Board accepted the Staff's presentation on this issue and examined the Staff's witnesses to determine that the Staff had sufficiently examined this topic to support the findings below.

4.38 The source term for radiological releases is the same as discussed in the tritium evaluation for liquid and gaseous effluent releases. Tr. 463:11.

4.39 The liquid pathway doses were calculated on a per-unit basis by Dominion and the Staff using the LADTAP-II computer program for activities such as eating fish and

invertebrates caught near the discharge point, for drinking water from Lake Anna, and for recreational purposes. Tr. 463:21.

4.40 The Staff used the dose estimates from the PPE source term as an input into the computer program. Other parameters input into the system included the effluent discharge rate and the dilution factor for discharge and transit time to the receptor locations. Tr. 464:5. The parameter information was taken from the Applicant's, and the Staff reviewed the parameters for reasonableness. The Staff conducted independent dose estimates and compared those to the Applicant's and to the 10 CF.R. Part 50, Appendix I design objectives. Tr. 464:7.

4.41 The liquid pathway doses to the maximally exposed individual per unit was estimated to be approximately 0.8 millirem per year compared to the design objective of 3 millirem per year, and the maximum organ dose was 2.5 millirem per year compared to the design objective of 10 millirem per year. Tr. 464:16.

4.42 Doses to the maximally exposed individual from reactor gaseous effluents were calculated on a per-unit basis using the GASPAR II computer program. The doses were calculated for several locations and included inputs such as meat and vegetable production rates, atmospheric dispersion factors, ground deposition factors, receptor locations, and consumption factors. Tr. 464:24.

4.43 The Staff reviewed the input parameters for reasonableness and conducted an independent calculation of the doses for comparison to 10 CFR Part 50, Appendix I Design Objectives. Tr. 465:13.

4.44 At the existing site, Virginia Electric and Power Company ("the Licensee") has conducted a radiological environmental monitoring program has been conducted around the North Anna Power Station since 1976. A preoperational program sampled various media and the environment to establish a baseline to determine the magnitude and fluctuation of radioactivity in the environment once the existing units began operation. Tr. 458:23.

4.45 The data and analysis in the Licensee's annual radiological environmental operating program report and the annual radiological effluent release report show that the doses to the maximally-exposed individual around the North Anna Power Station were a small fraction of the limits specified in the regulations. Tr. 458:17.

4.46 Modifications to the monitoring program are made based on changes in the areas such as milk production, changes in agricultural use and changes in lake use. The results of the program are summarized in the Licensee's annual radiological environmental operating program report, and results of the Licensee's effluent monitoring program are summarized in its annual radiological effluent release report. Tr. 458:9.

4.47 The Staff evaluated the health impacts from routine, gaseous and liquid effluents from the proposed nuclear units, and based on the information from Dominion and from its own calculations, the Staff concludes that there will be no observable health impacts to the public from the normal operation of the proposed units, and the radiological impacts would be "small," and mitigation is not warranted. Tr. 477:13.

4.48 The Staff concluded that with respect to radiological effluent releases and dose consequences from normal operations, appropriate long-term atmospheric dispersion coefficients established at the proposed site are acceptable for constructing one or two units falling within the Applicant's bounding, site-specific PPE, and that the site meets the relevant requirements of 10 C.F.R. Part 52, and 10 C.F.R. Part 100. Staff Ex. 2, p. 11-6; Tr. 469:8.

4.49 Staff employed a systematic, interdisciplinary approach integrating natural, environmental, and social sciences such as hydrology, aquatic biology, health physics, and eteorology, in evaluating the proposed action, as required by NEPA § 102(2)(A). The Staff described in detail in the FEIS the impacts of the proposed action, the adverse environmental effects of the proposed action that cannot be avoided, and alternatives to the proposed action, as required by NEPA § 102(2)(C). The Staff studied, developed and described appropriate

alternatives to the Staff's recommended action in accordance with NEPA § 102(2)(E). Further, the Staff examined the factors found in 10 C.F.R. § 100.21(c). Taking into consideration the site criteria contained in 10 C.F.R. Part 100, a reactor, or reactors, having the characteristics that fall within the parameters for the site can be constructed without undue risk to the health and safety of the public, thus supporting an affirmative finding on Safety Issue 2. Accordingly, the findings set forth above for this hearing topic augment the six mandatory findings set forth in the Staff's Written Statement of Position and support the issuance of the ESP. Having considered the above, we find that the Staff have adequately examined sources, release mechanisms, approximate contributions, pathways, and concentrations of tritium associated with the issuance of this ESP. Having considered the above, we find that the Staff have adequately examined radiological releases, pathways, and doses, confidence levels associated with the data, estimates, and calculations, the monitoring and the relevant regulatory standards for radiological releases associated with the issuance of this ESP.

E. Hearing Topic 5, "NEPA Alternatives"

4.50 The Board considered Hearing Topic 5, NEPA Alternatives, at the Evidentiary Hearing. The Board examined the Staff witnesses to determine how they met the requirements of NEPA in examining NEPA alternatives to the proposed action by reviewing alternate sites for a nuclear power plant, system design alternatives, other alternatives, and possible mitigation measures.

4.51 With respect to alternate sites, the need to compare the proposed North Anna ESP site with other alternative sites arises from the NEPA requirement that the NRC evaluate alternatives to issuance of an ESP for the North Anna site. *See* NEPA § 102(2)(C)(iii), 42 U.S.C. § 4332(c)(iii). The test to be employed in assessing whether a proposed ESP site is to be rejected in favor of any of the alternative sites considered is based on whether the alternative site is "obviously superior" to the site proposed by the applicant. *Public Service Co.*

of New Hampshire (Seabrook Station, Units 1 & 2), CLI-77-8, 5 NRC 503, 526 (1977), *aff'd*, *New England Coalition on Nuclear Pollution v. NRC*, 582 F.2d 87 (1st Cir. 1978). An alternative site is "obviously superior" to the proposed site if it is "clearly and substantially" superior to the proposed site. *Rochester Gas & Electric Corp.* (Sterling Power Project Nuclear Unit No. 1), ALAB-502, 8 NRC 383, 397 (1978), *aff'd*, CLI-80-23, 11 NRC 731 (1980). Further discussion of the requirements and the Staff process can be found in the NRC Staff's Written Statement of Position, dated April 10, 2007.

4.52 The Staff examined Dominion's region of interest ("ROI") for the possible siting of a new nuclear plant, as well as its alternative site selection process. Staff Ex. 3, p. 8-7 – 8-8. The ROI for searching for candidate sites used by Dominion included portions of the Midwest, Northeast, and Mid-Atlantic regions of the United States as a function of transmission system areas. Tr. 561:3. The ROI was quite large and covered approximately 25% of the U.S. land mass. Tr. 562:14.

4.53 The Staff evaluated how the ROI was narrowed to the candidate sites. *See generally* Staff Ex. 10, Response to Board Question 119. A candidate site is a site within the ROI that is among the best that can reasonably be found for the siting of a nuclear power plant. Tr. 562:22. The Staff's evaluation looked at four candidate sites, including the proposed site and three alternatives. Tr. 564:6.

4.54 The Staff looked at greenfield sites as potential candidate sites, but excluded them because of the burden of land-clearing and infrastructure construction of items such as transmission, transportation, and cooling water systems. Tr. 597:21. The Staff considered Dominion's alternative site selection process as it applies to greenfield and brownfield sites. A large land area would need to be disturbed to build a new nuclear power plant and to support necessary transmission line rights-of-way. The associated land use, ecological resource

impacts, and the aesthetic impacts would be large in comparison to impacts at sites with existing power plants. Staff Ex. 3, p. 8-10.

4.55 The Staff used the approach in NUREG-1555, the ESRP, to review the process used by the Applicant, and to determine whether the Applicant used a reasonable process to identify candidate sites, to identify the proposed site and the alternatives, and then to compare those sites. Tr. 572:1. During its review, the Staff considered the topics addressed by the Applicant, including the major issues of hydrology, water quality, aquatic biological resources, terrestrial resources, and transmission corridors. Tr. 565:22.

4.56 The Staff did not compare sites within ROI that have operating nuclear power plants, but which are owned by competitors of the Applicant, to the Applicant's proposed site, based on the Commission decision in the Seabrook case. Tr. 566:24. Dominion justifies the exclusion of competitor owned sites as reasonable based on its business interests and competitiveness, and considers building new nuclear units on a competitor's site as infeasible. Dominion estimates that there is no reasonable prospect a competitor would allow Dominion to build a large generating unit at its site. Dom. Ex. 3, p. 68.

4.57 Other nuclear sites exist within the ROI that are controlled by the U.S. Department of Energy ("DOE"). Because the DOE is not a competitor of Dominion, the Staff consideration included DOE sites that were interested in obtaining new missions. Tr. 581:7.

4.58 The Staff used the slate of sites that the Applicant had identified, determined that the process the Applicant used to identify those sites was reasonable, and that the slate of sites was reasonable. The Staff then evaluated the environmental impacts at the proposed alternative sites and formed an independent comparison of those sites to determine whether any was environmentally preferable to the proposed site. Tr. 572:9.

4.59 The Staff made sure that the sites put forward as candidate sites were strong candidate sites and, in the end, the Staff found that any of the candidate sites could host a new

nuclear power plant, and any of them would be a viable option for the siting of a new nuclear power plant. Tr. 584:10. The Staff concluded that the selected candidate sites are the best that could reasonably be found for siting of a nuclear power plant on an environmental basis within this specific ROI. Tr. 585:22, Tr. 569:20.

4.60 The candidate sites were the North Anna site, Dominion's Surry Power Station site in Surry County, Virginia, the DOE's Savannah River site in South Carolina, and the DOE's Portsmouth Gaseous Diffusion Plant in Ohio. Tr. 569:11, Staff Ex. 3, p. 8-6.

4.61 The Staff looked at the Dominion owned nuclear site, Millstone, but it was not considered good enough because of its location, size, population location, and nearby recreational areas. Tr. 579:7.

4.62 The Staff independently examined the alternative sites to determine whether any of the alternative sites was environmentally preferable. The Staff visited all of the alternative sites, spoke with site operators, gathered information in the local areas, and gathered information publicly available to determine what the environmental impacts would be at the alternative sites. Tr. 583:19.

4.63 The Staff developed the environmental impacts for each of the alternative sites, and then compared the proposed and alternative sites. All of the sites have some detriments where the environmental impacts rise above the level of "small" impact to "moderate" or perhaps "large." The Staff determined for both construction and for operation that while there were differences among the sites, none of the differences were so great that any of the alternative sites was environmentally preferable to the proposed site. Tr. 591:13.

4.64 The Staff addressed system design alternatives in its examination of alternative plant cooling systems for the proposed Unit 3. A dry cooling tower is proposed for Unit 4. Water and energy balance studies of Lake Anna suggested that a once-through cooling system,

a wet cooling tower heat dissipation system, or a combination wet and dry cooling system would be difficult for the lake to support for Unit 4. Staff Ex. 3, p. 8-2.

4.65 Staff analysis concluded that Lake Anna can support Unit 3 using a combination wet and dry cooling system. Staff Ex. 3, p. 8-5. The incremental addition of one unit to the current use of resources at the site supports a combination wet and dry system before the addition of any other significant water uses. Tr. 587:10.

4.66 The Staff employed a systematic, interdisciplinary approach integrating natural, environmental, and social sciences such as socio-economics, hydrology, aquatic biology, health physics, and meteorology, in evaluating the proposed action, as required by NEPA § 102(2)(A). The Staff described in detail in the FEIS the impacts of the proposed action, the adverse environmental effects of the proposed action that cannot be avoided, and alternatives to the proposed action, as required by NEPA § 102(2)(C). The Staff studied, developed and described appropriate alternatives to the Staff's recommended action in accordance with NEPA § 102(2)(E). Accordingly, the findings set forth above for this hearing topic augment the six mandatory findings for the four NEPA issues set forth in the Staff's Written Statement of Position and support the issuance of the ESP. Having considered the above, we find that the evidence in the record supports a conclusion that the Staff has considered all reasonable alternatives to the proposed site and their environmental impacts.

F. Hearing Topic 6, "Zero Release Commitment"

4.67 The Board considered Hearing Topic 6, Zero Release Commitment, at the Evidentiary Hearing. The Board examined the Staff witnesses to determine that the Staff has sufficiently examined this topic to support the findings below.

4.68 The requirements of 10 C.F.R. § 100.20(c)(3) requiring the measurement of factors important to the hydrological radionuclide transport cannot be meaningfully examined at

the ESP stage, but the ESP site does not have any intrinsic characteristics that would make it unsuitable for issuance of the ESP. Tr. 219:4, Tr. 218:16.

4.69 Because the hydrological radionuclide transport factors cannot be meaningfully examined at this stage, a permit condition is used to preclude accidental releases using design and engineering features. Tr. 219:18, Tr. 219:25.

4.70 Permit Condition 3.E.(3) in the proposed ESP requires that any new unit's radioactive waste management systems, structures, and components include features to preclude accidental releases of radionuclides into potential liquid pathways. Staff Exh. 17, at 3.

4.71 The permit condition conforms to the language adopted by the Commission in similar proceedings. Tr. 615:14. *See System Energy Resources, Inc.* (Early Site Permit for Grand Gulf ESP Site), CLI-07-14, 65 NRC __ (March 27, 2007), slip op. at 2-3; *Exelon Generation Co., LLC* (Early Site Permit for Clinton ESP Site), CLI-07-12, 65 NRC __ (March 8, 2007), slip op. at 3-4.

4.72 Regulatory Guide 1.143 provides substantial details about standards applied to different categories of components of radiological waste systems in order to preclude accidental releases of radionuclides. Tr. 626:21. Devices that are more protective than the Regulatory Guide 1.143 could be used in the design and construction to comply with the permit condition. Tr. 628:16.

4.73 The FEIS partially does not address impacts to groundwater because the permit condition would require the inclusion of features that would preclude releases, and the Staff saw no indication from existing data of contamination in the groundwater from accidental releases Tr. 636:10.

4.74 The current data and analysis in the Licensee's Radiological Environmental Monitoring Program Annual Report and annual Radiological Effluent Release Report show that

the radiological doses to the maximally exposed individual around the North Anna Power Station were a small fraction of the limits specified in the Federal Regulations. Tr. 458:12.

4.75 Having considered the above and the evidence in the record, we find that the Staff has complied with 10 C.F.R. § 100.20(c)(3) and has adequately examined the zero release commitment associated with the issuance of this ESP, in conformance with the Commission holdings on this issue, in that there will be no reasonably foreseeable impacts as a result of Permit Condition 3.E.(3). Taking into consideration the site criteria contained in 10 C.F.R. Part 100, a reactor, or reactors, having the characteristics that fall within the parameters for the site can be constructed without undue risk to the health and safety of the public, thus supporting an affirmative finding on Safety Issue 2.

G. Hearing Topic 7, "Seismic Safety"

4.76 The Board considered Hearing Topic 7, Seismic Safety, at the Evidentiary Hearing. The Board accepted the Staff's presentation on this issue and examined the Staff's witness to determine that the Staff has sufficiently examined this topic to support the findings below.

4.77 The Staff's seismic safety review consisted of three principal parts: regional and site geology; the safe shutdown earthquake ("SSE") vibratory ground motion; and the potential for surface deformation. Tr. 645:19.

4.78 These three areas of review are governed by NRC regulatory requirements in 10 C.F.R. Part 100. 10 C.F.R. § 100.23(c) states, in pertinent part:

> The geological, seismological, and engineering characteristics of a site and its environs must be investigated in sufficient scope and detail to permit an adequate evaluation of the proposed site, to provide sufficient information to support evaluations performed to arrive at estimates of the [SSE] Ground Motion, and to permit adequate engineering solutions to actual or potential geologic and seismic effects at the proposed site.

Further, 10 C.F.R. § 100.23(d)(1) requires, in pertinent part, that uncertainties that are inherent in seismic hazard estimates "be addressed through an appropriate analysis, such as a probabilistic seismic hazard analysis or suitable sensitivity analyses." Finally, 10 C.F.R. § 100.23(d)(2) requires that "sufficient geological, seismological, and geophysical data must be provided to clearly establish whether there is a potential for surface deformation." Overall, the regulatory requirements specify a probabilistic approach to seismic hazard characterization. *See* Tr. 646:3.

4.79 In performing its seismic safety review, the Staff used, among other guidance documents, Regulatory Guide ("RG") 1.165, "Identification and Characterization of Seismic Sources and Determination of Safe Shutdown Earthquake Ground Motion," issued in March 1997, which sets forth methods acceptable to the Staff for complying with 10 C.F.R. § 100.23(c): specifically (1) conducting geological, geophysical, seismological, and geotechnical investigations; (2) identifying and characterizing seismic sources; (3) conducting probabilistic seismic hazard analyses ("PSHA"); and (4) determining the SSE for satisfying the requirements of 10 C.F.R. § 100.23. Tr. 646:20.

4.80 Regarding regional and site geology, the Applicant used areal source zones for the Central and Eastern United States ("CEUS") by the Electric Power Research Institute ("EPRI"). Tr. 647:12. The Staff reviewed the Applicant's geologic description in Sections 2.5.1 and 2.5.2 of the site safety analysis report ("SSAR") to determine whether the EPRI CEUS seismic source characterizations needed to be updated. *See* Staff Ex. 1, § 2.5.1.1.1; Staff Ex. 6, Response to Board Question 53. The Staff ultimately concurred with the Applicant's determination to update only the Charleston, South Carolina, seismic source zone magnitudes and recurrence values.

4.81 In addition, the Staff probed the Applicant's characterization of several regional and local faults. In particular, the Applicant identified seven bedrock faults within a 5-mile radius of the ESP site, including unnamed faults "a," "b," and "c," and, based on site area investigations and a review of published literature, concluded that none of the faults is a capable tectonic source, as defined in RG 1.165. Staff Ex. 1, p. 2-166. As part of its review of the ESP application, the Staff reviewed the Applicant's description of the site area structural geology, focusing particularly on the fault closest to the ESP site, unnamed fault "a," which traverses the site and was discovered during excavation for abandoned Units 3 and 4. Tr. 649:17. At that time, Virginia Power, the NRC Staff, and their respective consultants performed detailed investigations, including mapping the excavation fault exposures, a detailed soil profile analysis, and interpretation of aerial photography. Staff Ex. 6, Response to Board Question 54.

4.82 During its review of the North Anna ESP application, the Staff confirmed that its earlier conclusions regarding unnamed fault "a" remained valid. Tr. 650:6; Staff Ex. 6, Response to Board Question 54. In order to evaluate the Applicant's characterization of fault "a" (and its other geologic investigations), the Staff sought the assistance of the U.S. Geological Survey ("USGS"). The Staff and USGS advisors visited the ESP site, and met with the Applicant to discuss the information presented by the Applicant regarding potential geologic faulting near the North Anna ESP site. Staff Ex. 6, Response to Board Question 54.

4.83 The Staff concluded that the Applicant performed its investigations in accordance with 10 C.F.R. § 100.23 and RG 1.165, and provided an adequate basis to establish that no capable tectonic sources exist in the site vicinity that would cause surface deformation in the site area. Staff Ex. 1, p. 2-209. However, to confirm this conclusion, the Staff proposed Permit Condition 7, requiring that the Staff be notified no later than 30 days after any site excavations for safety-related structures are opened, in order to examine and evaluate all geologic features. *See* Staff Ex. 1, § 2.5.1.3.2; Staff Ex. 6, Response to Board Question 54.

4.84 FSER Section 2.5.2 presents the Staff's evaluation of ground motion at the ESP site from possible earthquakes that might occur in the site region and beyond. Staff Ex. 1, p. 2-189. According to RG 1.165, applicants may develop the vibratory ground motion for a new nuclear power plant using either the EPRI or Lawrence Livermore National Laboratory ("LLNL") PSHAs for the CEUS. To estimate the vibratory ground motion at the ESP site from each of the seismic sources, the Applicant used a probabilistic approach recommended by RG 1.165. Tr. 650:10. In particular, RG 1.165 recommends that applicants perform geological, seismological, and geophysical investigations and evaluate any relevant research to determine whether revisions to the EPRI or LLNL PSHA databases are necessary. Staff Ex. 1, p. 2-190. As such, the Staff focused its review on geologic and seismic data published since the late 1980s that could indicate a need for changes to the EPRI or LLNL PSHAs. Staff Ex. 1, p. 2-190.

4.85 In considering the probabilistic approach used by the Applicant, the Staff reviewed the Applicant's updates of the regional seismic source zones and current ground motion models. Tr. 650:13. The Staff also verified the adequacy of the controlling earthquakes for the site. The reference probability, discussed above, is used to determine the controlling earthquakes for the site. Staff Ex. 6, Response to Board Question 57. The controlling earthquakes are determined in terms of a magnitude and distance for both a low-frequency distant earthquake and a high-frequency local earthquake. For the North Anna site, the local controlling earthquake is a magnitude 5.4 earthquake at 12 miles, and the distant controlling earthquake is a magnitude of 7.2 at a distance of 191 miles. Tr. 650:17; Staff Ex. 1, § 2.5.2.3.4.

4.86 In order to determine the SSE, the Applicant used a revised reference probability value, which is specifically envisioned by Appendix B to RG 1.165. RG 1.165 at 1.165-12. The "reference probability" is, at bottom, an annual probability of exceeding the SSE ground motion

at a proposed power plant site. In particular, it is the annual probability level such that 50 percent of a set of currently operating plants (selected by the NRC) has an annual medial probability of exceeding the SSE that is below this level. RG 1.165 , p. 1.165-12. Put another way, the reference probability is the average probability of exceeding the SSE ground motion at 5 Hz and 10 Hz, using either the 1993 LLNL PSHA or the 1989 EPRI PSHA. Staff Ex. 1, p. 2-177, Staff Ex. 6, Response to Board Question 57.

4.87 The reference probability recommended by RG 1.165 is 1×10^{-5} per year, based on *median* seismic hazard curves. Tr. 651:2. The Applicant decided to use a higher reference probability, 5×10^{-5}, than that recommended by RG 1.165. Tr. 651:4; Staff Ex. 1, p. 2-199. In addition, the Applicant used the *mean* PSHA curves, rather than the *median* curves. Tr. 651:4; Staff Ex. 1, p. 2-199.

4.88 The Staff performed a confirmatory analysis of the Applicant's revised reference probability. Since the early 1990s, when the reference probabilities of the CEUS sites addressed in RG 1.165 were determined, new ground motion models have been developed for the CEUS. Tr. 652:3. In addition, recurrence values, the interval between large earthquakes for the New Madrid and the Charleston, South Carolina earthquake zones have decreased. Tr. 652:7. These factors imply that, if the 29 CEUS reference probabilities were to be recalculated, some might increase such that the overall composite reference probability would differ from the 1×10^{-5} value. Tr. 652:10.

4.89 In order to evaluate the Applicant's use of the higher reference probability, and the use of mean, rather than median, PSHA results, the Staff performed an independent analysis to re-evaluate the reference probabilities for the 29 sites in the CEUS that were used to determine the original reference probability. Staff Ex. 1, p. 2-200. For this analysis, the Staff used the most recent (2002) USGS PSHA mean and median hazard curves to determine the probability of exceeding the SSEs for the 29 CEUS sites. Staff Ex. 1, p. 2-200. Using the 2002

USGS PSHA results, the Staff calculated reference probability values closer to 10^{-4} (median 6 to 7 x 10^{-5} and mean 8 to 9 x 10^{-5}). This calculation served to verify that the overall trend in seismic hazards has increased for the CEUS. Staff Ex. 6, Response to Board Question 60. Although the Staff has not officially endorsed the 2002 USGS PSHA results, the calculation, in short, verified that the reference probability proposed by the Applicant (5 x 10^{-5}) is sufficiently conservative. Staff Ex. 1, p. 2-200.

4.90 Even though the overall seismic hazard would increase, as compared to the use of the recommended reference probability in RG 1.165, the use of the Applicant's higher reference probability to determine the SSE is justified because, as discussed above, the Staff made a reasonable determination that the Applicant's proposed higher reference value is approximately the value that would be determined for the CEUS sites using *current* ground motion models and seismic source zone characterizations. *See* Staff Ex. 6, Response to Board Question 63. Further, the fact that the overall seismic hazard would increase does not equate to a "riskier" site from a seismic standpoint. Although the higher reference probability would result in increased high frequency ground motions, the Staff determined that those high frequency ground motions do not generally damage robust nuclear power plant structures. Tr. 683:15.

4.91 The Staff's review of the stability of subsurface materials and foundations at the ESP site is documented in section 2.5.4 of the FSER. In particular, the Staff considered the engineering properties of subsurface materials; previous subsurface investigations and the ESP exploration program; geophysical investigations performed at the site; the extent of anticipated excavations, fills, and slopes; the groundwater conditions at the site; the response of subsurface materials to dynamic loading; and the site's liquefaction potential. *See generally* Staff Ex. 1, pp. 2-209 – 2-242.

4.92 In support of its geotechnical review, in the pre-application phase, the Staff visited the North Anna ESP site to observe the geotechnical field explorations. Tr. 652:22. Upon receipt of the ESP application, the Staff reviewed the properties of the subsurface soil and rock, and verified the adequacy of the Applicant's field investigations and laboratory testing. Tr. 652:24. In addition, the Staff confirmed the similarity between the subsurface material underlying the current North Anna site, and the ESP site. Tr. 653:2.

4.93 Having considered the above, we find that the Staff has adequately examined regional and site geology, vibratory ground motion, and site subsurface materials in conjunction with the seismic review associated with the issuance of this ESP.

4.94 With respect to seismic safety, including the geology and seismology of the proposed ESP site and nature, adequacy, and confidence levels associated with the data and standards used by the Staff to assess the proposal, this Board finds that the Applicant has met 10 C.F.R. § 100.23. Accordingly, taking into consideration the site criteria contained in 10 C.F.R. Part 100, a reactor, or reactors, having the characteristics that fall within the parameters for the site can be constructed without undue risk to the health and safety of the public. The findings set forth above in ¶¶ 4.76 - 4.93 augment the Staff's findings on Safety Issue 2 in its Written Statement, and support this Board's affirmative finding regarding Safety Issue 2.

V. CONCLUSIONS OF LAW

5.1 The conclusions of law set forth in the Staff's April 10, 2007 Written Statement are herein incorporated by reference.

5.2 The Board has, in attempting to fulfill its mandatory hearing obligations discussed above, reviewed the material portions of the record in this proceeding. Based upon that review, we have reached the following determinations:

5.3 With respect to safety issues, the Board has determined that the application and the record of the proceeding contain sufficient information, and that the review of the application by the Staff has been adequate, to support findings in accordance with the Notice of Hearing, that (1) the issuance of an early site permit will not be inimical to the common defense and security or to the health and safety of the public; and (2) taking into consideration the site criteria contained in 10 C.F.R. Part 100, a reactor, or reactors, having the characteristics that fall within the parameters for the site, can be constructed and operated without undue risk to the health and safety of the public.

5.4 With respect to environmental issues, the Board has determined that the review conducted by the Staff pursuant to 10 C.F.R. Part 51 has been adequate, in accordance with the Notice of Hearing, *see also* 10 C.F.R. § 2.104(b)(2)(ii). In addition, the Board finds that (1) the requirements of sections 102(2)(A), (C), and (E) of NEPA have been satisfied; (2) having conducted its own independent balancing of the conflicting environmental and other factors (including an analysis to determine that there are no obviously superior sites), that the overall balance supports issuance of the license; and (3) protection of the environment requires further conditioning of the license, as discussed in the FEIS. The Board thus concludes that these factors support issuance of the requested early site permit.

For the foregoing reasons, it is [on this date], ORDERED, that, in accordance with 10 C.F.R. § 2.340, this decision shall become immediately effective. Further, in accordance with 10 C.F.R. § 2.713, this decision shall constitute the final decision of the Commission forty (40) days from the date of issuance, unless a petition for review is filed in accordance with 10 C.F.R. § 2.341, or unless the Commission directs otherwise.

UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

BEFORE THE ATOMIC SAFETY AND LICENSING BOARD

In the Matter of	)	
	)	
DOMINION NUCLEAR NORTH ANNA, LLC	)	Docket No. 52-008-ESP
	)	
(Early Site Permit for North Anna ESP Site)	)	

CERTIFICATE OF SERVICE

I hereby certify that copies of the "NRC STAFF'S PROPOSED FINDINGS OF FACT AND CONCLUSIONS OF LAW IN THE MANDATORY HEARING" have been served on the following through deposit in the NRC's internal mail system, with copies by electronic mail, as indicated by an asterisk, and by deposit in the U.S. mail, first class postage prepaid, with copies by electronic mail, as indicated by double asterisk, this 11th day of May, 2007:

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