RAS 13610

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
	)	
(Early Site Permit for North Anna ESP Site)	)	ASLBP No. 04-822-02-ESP

DOMINION'S PROPOSED FINDINGS OF FACT AND CONCLUSIONS OF LAW

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May 11, 2007

TABLE OF CONTENTS

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In accordance with the Atomic Safety and Licensing Board's Second Revised Scheduling Order (Jan. 4, 2007) in this proceeding, Dominion Nuclear North Anna, LLC hereby submits its proposed findings of fact and conclusions of law relating to its application for an Early Site Permit. The proposed findings and conclusions below are presented in the form of an initial decision that could be issued by the Board.

I. Introduction and Background

This initial decision sets forth the findings of the Board on the uncontested issues required to be considered in a mandatory hearing on the application of Dominion Nuclear North Anna, LLC ("Dominion") for an early site permit ("ESP") for the North Anna ESP Site ("Dominion's Application"). As described below, the Board finds that the NRC Staff's review of Dominion's Application has been adequate and the record of this proceeding is sufficient to support the safety findings required for issuance of this ESP. The Board also finds that the NRC Staff's environmental review pursuant to the National Environmental Policy Act ("NEPA") has been adequate, that NEPA and the implementing regulations have been satisfied, and based on the pertinent considerations, that the ESP should be issued.

A. Dominion's Application

Dominion's Application, submitted in September 2003, seeks an early site permit for a location in central Virginia identified as the North Anna ESP Site (the "ESP Site"). The ESP Site is a parcel of land on the North Anna Power Station ("NAPS") in Louisa County, Virginia, approximately 40 miles north-northwest of Richmond. NAPS Units 1 and 2, and an independent spent fuel storage installation ("ISFSI") are already located on the NAPS site. The ESP Site would be adjacent to, and generally west of the existing units.

Dominion's Application seeks the NRC's approval of the ESP Site as suitable for two new nuclear units. Each new unit could consist of one or more modules or reactors with a total capacity per unit not exceeding 4,500 MW thermal. Dominion's Application does not seek any approval to build or operate these units. Such authorization would be sought separately, in a combined construction permit and operating license ("combined license" or "COL") proceeding, if Dominion decides in the future to proceed with the development of the new reactors. In addition, Dominion's Application does not seek approval of the site as suitable for any specific reactor design, but instead seeks a determination that the site is suitable for units with characteristics bounded by a plant parameter envelope ("PPE").[1]

Dominion's Application and this proceeding are governed by 10 C.F.R. Part 52, Subpart A, which sets out the requirements and procedures applicable to the issuance of an ESP separate from the filing of an application for a construction permit or combined license. Early site

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[1] Dominion's Application states:

> . . . Dominion has not selected a particular reactor design to be constructed at the ESP site. Thus, in order to provide sufficient design information to enable the NRC to determine that the proposed site is suitable for new units, a surrogate design has been provided as part of the application. The surrogate plant is in the form of a set of bounding plant parameters termed the plant parameters envelope....

Dom. Exh. 11, § 1.2.1. See also Staff Exh. 1 (SER) at 1-5.

permitting, along with process for issuance of design certifications and combined licenses, was established with the promulgation of 10 C.F.R. Part 52 in 1989 "to achieve the early resolution of licensing issues, thereby enhancing the safety and reliability of nuclear power plants, and reducing the complexity and uncertainty of the license process." 53 Fed. Reg. 32,060 (Aug. 23, 1988).

> Part 52 is intended to improve the licensing of nuclear power plants by the use of three procedural innovations. . . . Subpart A of Part 52 formalizes the early site permit process, allowing a prospective applicant to obtain a permit for one or more pre-approved sites on which future nuclear power stations can be located. Subpart B carries forward the standard design approval process . . . in much the same way, allowing a prospective applicant, vendor, or other interested party to obtain Commission approval of a design of a complete nuclear power plant or a major portion of such a plant. Subpart C establishes procedures for the issuance of a combined construction permit and conditional operating license. . . .
>
> This structure reveals the overall purpose of Part 52: to improve reactor safety and to streamline the licensing process by encouraging the use of standard designs and by permitting early resolution of environmental and safety issues related to the reactor site and design.

Id. at 32,062.

> The Commission's intent with this rulemaking is . . . to have a sensible and stable procedural framework in place for the consideration of future designs, and to make it possible to resolve safety and environmental issues before plants are built, rather than after.

54 Fed. Reg. 15,372, 15,373 (Apr. 18, 1989).

Under the 10 C.F.R. Part 52, Subpart A rules, an applicant for an ESP must submit a description and safety assessment of the site on which the facility is to be located. 10 C.F.R. § 52.17(a)(1). In the hearing on the ESP application, the presiding officer must "determine whether, taking into consideration the site criteria contained in 10 CFR part 100, a reactor, or reactors, having 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." 10 C.F.R. § 52.21. Thus, with respect to the safety assessment, the focus of this proceeding is whether the site meets

certain NRC siting criteria that would allow a plant with postulated characteristics to be constructed and operated safety.[2]

An ESP proceeding is not intended to resolve design issues or approve the construction or operation of new facilities. Rather, design parameters are postulated by the applicant, and the ESP proceeding then determines whether the site is suitable for one or more reactors falling within the bounds of those postulated characteristics.[3] This approach is reflected in the NRR Review Standard RS-002, "Processing Applications for Early Site Permits" (May 3, 2004), which the NRC Staff issued with the Commission's approval.[4] Review standard RS-002 allows an applicant to use a PPE as a surrogate for facility design information and explains:

> A PPE is a set of values of plant design parameters that an ESP applicant expects will bound the design characteristics of a reactor or reactors that might be constructed at a given site, and its serves as a surrogate for actual reactor design information. Use of this approach allows an ESP applicant to defer the decision on what to build to the COL stage.
>
> Given that PPE values do not reflect a specific design and will not be reviewed by the NRC staff for correctness, the granting of an ESP by the NRC does not indicate NRC approval of the site for any specific plant or type of plant.
>
> The combination of site characteristics and PPE values will comprise the bases that will be the focus for comparison should a COL application be submitted for the site. COL applicants who reference an ESP bear the risk that the design

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[2] At the COL stage, the applicant must "demonstrate that the design of the facility falls within the parameters specified in the early site permit." 10 C.F.R. § 52.79(a)(1).

[3] The Part 52 regulations formalized an early site approval process that had been in partial use for a number of years before the regulations were adopted. 53 Fed. Reg. at 32,062. In establishing early site review procedures in the mid-1970's, the Commission explained:

> [T]he conduct of an early review of one or more site suitability issues will require a "decoupling" of site suitability issues from issues concerning the detailed facility design. However, some information about the nature of the proposed facility will clearly be required for the conduct of the review. Accordingly, some facility design parameters (or reasonable range of facility design parameters) must be postulated for purposes of review.

41 Fed. Reg. 16,835 (Apr. 22, 1976).

[4] See Memorandum from Annette L. Vietti-Cook to William D. Travers, "Staff Requirements - SECY-03-0227 – Review Standard RS-002, 'Processing Applications for Early Site Permits'" (Mar. 15, 2004).

ultimately selected for the approved site might fall outside of the terms and conditions of the ESP.

Staff Exh. 14 (RS-002) at 16. See also Staff Exh. 16 (Cushing Test.) at 2-3.

Similarly, under the 10 C.F.R. Part 52, Subpart A rules, an ESP applicant must submit an environmental report "focus[ing] on the environmental effects of construction and operation of a reactor, or reactors, which have characteristics that fall within the postulated site parameters. . ." 10 C.F.R. § 52.17(a)(2). As discussed in RS-002, the PPE approach can serve as the foundation for the environmental report. Staff Exh. 14 (RS-002), Att. 3 at. 1. In such cases, detailed design information called for by the ESRP need not be submitted. Id. at 2. If PPE values are used as a surrogate for design-specific values, the ESP applicant need not provide a one-to-one replacement of the design specific values, but should provide sufficient information for the NRC Staff to develop a reasonable independent assessment of potential impacts to specific environmental resources. Id.

Dominion's Application was amended a number of times during the course of the NRC's review, mainly to incorporate responses to NRC requests for additional information ("RAI"). In addition, in October 2005, Dominion decided to modify its approach for cooling a third unit, changing the approach from once-through cooling to a combination of wet and dry cooling towers. The revised approach, which Dominion adopted to address concerns of state regulatory bodies and local residents, essentially eliminated any significant thermal impact from new units while at the same time reducing the proposed consumptive water use. This is a very substantial mitigative commitment, indeed one that will add over $200 million to the cost of a third unit. Tr. 186-89 (Waddill). The changes in cooling approach and related analyses, and responses to related questions from the NRC Staff, were incorporated into Revision 6 of Dominion's Application, which also increased the maximum power level per unit to correspond to the power

level proposed in design certification proceeding for the ESBWR. Revision 9 of Dominion's Application, dated September 2006, is the final version and was admitted into evidence as Dominion Exhibit 11.

B. NRC Staff's Review

Upon receipt of Dominion's Application, the NRC Staff conducted an initial sufficiency review of the Application. On October 23, 2003, after finding Dominion's Application sufficiently complete, the NRC Staff accepted the Application for docketing and review. 68 Fed. Reg. 61,705 (2003). The NRC Staff then performed both a safety review and an environmental review.

The NRC Staff's safety review is documented in its Safety Evaluation Report ("SER") – NUREG-1835, "Safety Evaluation Report for an Early Site Permit (ESP) at the North Anna ESP Site" (Sept. 2005) (admitted into evidence as Staff Exh. 1), and SER Supplement (Nov. 2006) (admitted into evidence as Staff Exh. 2). The SER Supplement evaluates the changes in the proposed cooling system and power level that were made in Revision 6 of Dominion's Application. As stated therein:

> On the basis of its evaluation and independent analyses as discussed in this supplement and NRC technical report NUREG-1835, "Safety Evaluation Report for an Early Site Permit (ESP) at the North Anna ESP Site," the staff concludes that the North Anna ESP site characteristics comply with the requirements of 10 CFR Part 100, "Reactor Site Criteria," with the limitations and conditions proposed by the staff in this supplement and NRC technical report NUREG-1835 for inclusion in any ESP that might be issued. Further, for the reasons set forth in this supplement and NRC technical report NUREG-1835, the staff concludes that, taking into consideration the site criteria contained in 10 CFR Part 100, a reactor, or reactors, having characteristics that fall within the parameters for the site, and which meets the terms and conditions proposed by the staff in this supplement and NRC technical report NUREG-1835, can be constructed and operated without undue risk to the health and safety of the public. For the same reasons, the staff also concludes that issuance of the requested ESP will not be inimical to the common defense and security or to the health and safety of the public.

Staff Exh. 2 (SER Supp.) at 19-1

Dominion's Application and NRC Staff's SER have been reviewed by the Advisory Committee on Reactor Safeguards ("ACRS"). The ACRS Report, which is provided as Appendix E to the SER, states, "[t]he staff has prepared a high-quality, detailed, yet readable, safety evaluation report on the Dominion application." Staff Exh. 1 (SER), App. E at E-3. The ACRS concurs with the NRC Staff's conclusions (id. at E-4) and states:

> The proposed site, subject to the permit conditions recommended by the NRC staff, can be used for up to two nuclear power units each of up to 4300 MW_{th} without undue risk to the public health and safety.

Id. at E-1.[5]

The NRC Staff's environmental review began with a scoping process, which included public meetings and opportunities for the public to submit comments on the scope of environmental review. Staff Exh. 16 (Cushing Test.) at 3. The results of this scoping process were documented in a June 24, 2004 report. Staff Exh. 3 (FEIS.), App. D. See Dom. Exh. 10 (Dom. Env. Test.) at 9. The NRC Staff then prepared a draft environmental impact statement and solicited comments from other agencies and the public. Staff Exh. 16 (Cushing Test.) at 3; Dom. Exh. 10 (Dom. Env. Test.) at 9. After Dominion revised its proposed cooling system for a third unit, the NRC Staff prepared a supplemental draft environmental impact statement and again sought comments from other agencies and the public. Staff Exh. 16 (Cushing Test.) at 4; Dom. Exh. 10 (Dom. Env. Test.) at 10. Twenty-eight members of the NRC Staff and thirty-one scientists and other personnel for the Pacific Northwest National Laboratory participated in the preparation of the environmental impact statement. See Staff Exh. 1 (SER), App. A. During its

[5] In an October 13, 2006 memorandum included as Appendix E to the SER Supplement, the ACRS determined that the change in cooling water system and change in power level do not affect its conclusions and recommendation. Staff Exh. 2 (SER Supp.), App. E at E-1.

independent review, the NRC Staff contacted approximately 60 organizations, including Federal, State, regional, Tribal and local agencies. See id., App. B.

After considering all comments, the NRC Staff issued its final environmental impact statement ("FEIS"), which it published as NUREG-1811, Environmental Impact Statement for an Early Site Permit (ESP) at the North Anna Site, Final Report (Dec. 2006) (admitted into evidence as Staff Exh. 3). Therein, the NRC Staff concluded:

> The staff's recommendation, after consideration of the environmental impacts described in this Final EIS, is that an ESP for North Anna Units 3 and 4 should be issued. This recommendation is based on (1) the ER submitted by Dominion; (2) consultation with Federal, State, Tribal and local agencies; (3) the staff's independent review; (4) the staff's consideration of public comments related to the environmental review that were received during the review process; and (5) the assessments summarized in this Final EIS, including the potential mitigation measures identified in the ER and in this Final EIS. In addition, in making its recommendation, the staff has concluded that the alternative sites considered are not obviously superior to the proposed site. Finally, the staff concludes that the site preparation and preliminary construction activities enumerated in 10 CFR 50.10(e)(1) would not result in any significant adverse environmental impact that cannot be redressed.
>
> A comparative summary showing the environmental impacts of constructing and operating two new units at the North Anna ESP site or at any of the alternative sites is shown in Table 10-1. The estimated environmental significance of the no-action alternative, or denial of the ESP application, is also shown. Table 10-1 shows that the significance of the environmental impacts of the proposed action is SMALL for all impact categories at all sites with the exception of certain land use, ecology, water use and quality, socioeconomic, and historic and cultural resource impacts. The alternative sites may have adverse environmental effects in at least some categories that reach MODERATE to LARGE significance.
>
> The range of impacts estimated by the NRC staff for resolved issues is predicated on certain assumptions that are identified in each section. Should the Commission issue an ESP for the North Anna ESP site, and it is referenced in an application for a CP or COL, the staff will verify that the assumptions identified in this Final EIS remain applicable. In addition, certain issues are not resolved because of a lack of information. An applicant for a CP or COL referencing an ESP for the North Anna ESP site would need to provide the necessary information to resolve these issues, if the proposed action ultimately would affect the resources associated with these issues.

Staff Exh. 3 (FEIS) at 10-11. See also Staff Exh. 16 (Cushing Test.) at 5.

C. Procedural Background

After Dominion's Application was docketed, the NRC published a notice of hearing and opportunity for petitions for leave to intervene. 68 Fed. Reg. 67,489 (Dec. 2, 2003). Because an ESP is considered a partial construction permit, this notice reflects the mandatory hearing requirement in Section 189a(1)(A) of the Atomic Energy Act, and requires the Board not only to preside over the adjudication of any contentions admitted in the proceeding but also to make determinations on certain uncontested matters.

The Blue Ridge Environmental Defense League, the Nuclear Information and Resource Service, and Public Citizen ("Intervenors") filed a timely request for hearing and petition to intervene.[6] The Board, as originally constituted, concluded that the Intervenors had standing and had submitted two admissible contentions.[7] One of those contentions, relating to consideration of the no-action alternative, was settled in early 2005.[8] The other, relating to whether Dominion's environmental report had adequately considered the impacts of new units on striped bass in Lake Anna and down stream resulting from increased water temperature, was resolved by summary disposition after Dominion changed its cooling method for proposed reactor Unit 3

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[6] Hearing Request and Petition to Intervene by [Intervenors] (Jan. 2, 2004).

[7] LBP-04-18, 60 N.R.C. 253, 270-72, 276 (2004). As originally constituted, the Board consisted of the then-Chief Administrative Judge G. Paul Bollwerk, III, Associate Chief Administrative Judge Anthony J. Baratta (Technical), and Special Associate Chief Administrative Judge Paul B. Abramson (Technical/Legal), 69 Fed. Reg. 15,910 (Mar. 26, 2004). The Board was later reconstituted with its current members. 69 Fed. Reg. 49,916 (Aug. 12, 2004).

[8] Licensing Board Order (Approving Settlement and Dismissal of Contention EC 3.3.4) (Jan. 6, 2005) (unpublished).

from once-through cooling water to a closed-cycle cooling system.[9] With the resolution of this last contention, the contested portion of this hearing was terminated.[10]

Upon completion of the NRC Staff's review and publication of Supplement 1 to the SER and FEIS, the Board commenced the uncontested portion of the mandatory hearing. After reviewing the SER including Supplement 1, the Board issued an Order on January 18, 2007, requiring both Dominion and the NRC Staff to respond to 116 safety questions. Similarly, after reviewing the FEIS, the Board issued an Order on February 7, 2007, requiring both Dominion and the NRC Staff to respond to 132 questions on environmental matters. After considering the responses of the parties, the Board then issued a scheduling order requiring Dominion and the NRC Staff to prefile such testimony and exhibits as each deemed necessary to present its case. In addition, the scheduling order designated seven topics for oral presentation and questioning at an evidentiary hearing.

The evidentiary hearing was held in Louisa County, Virginia, from April 24 through April 26, 2007. At the hearing, the NRC Staff presented a number of exhibits that were admitted into evidence, including: (1) the SER and Supplement (Staff Exhs. 1 and 2); (2) the FEIS (Staff Exh. 3); (3) the ACRS Report (Staff Exhs. 4 and 5); (4) the Staff's answers to the Board's safety questions (Staff Exhs. 6 – 9); (5) the Staff's answers to the Board's environmental questions (Staff Exhs. 10-13); (6) Prefiled Direct Testimony of George Wunder on Health and Safety Issues (Staff Exh. 15) ("Wunder Test."); and (7) Prefiled Direct Testimony of John Cushing on Environmental Issues (Staff Exh. 16) ("Cushing Test."). Dominion also presented a number of exhibits that were admitted into evidence, including (1) Dominion's Application (Dom. Exh. 11);

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[9] Dominion Nuclear North Anna, LLC (Early Site Permit for North Anna ESP Site), LBP-06-24, 64 N.R.C. 360 (2006).

[10] Id. at 365.

(2) prefiled testimony on safety matters (Dom. Exh. 9) ("Dom. Safety Test."); (3) prefiled testimony on environmental matters (Dom. Exh. 10) ("Dom. Env. Test."); (4) Dominion's answers to the Board's safety questions (Dom. Exhs. 1 and 2); and (5) Dominion's answers to the Board's environmental questions (Dom. Exhs. 3-8). In addition, the NRC Staff and Dominion each presented panels of witnesses who provided presentations and responded to questions from the Board on the seven topics specified in the Board's scheduling order.

At the end of the evidentiary hearing, Dominion requested leave to submit additional information relating to a question that the Board had asked concerning the alternative site review. The Board granted Dominion's request, allowing Dominion to provide this information by May 7, 2007, and the NRC Staff to provide any response by May 11, 2007. Tr. 790, 799-800.[11] With this exception and with corrections to the transcript submitted on May 9, 2007, the record was closed.

II. Scope and Standards Governing the Mandatory Hearing

As delineated in the Notice of Hearing, there are a number of issues that the Board must decide. With respect to safety matters, the Board must determine:

- whether the application and the record of the proceeding contain sufficient information, and the review of the application by the NRC Staff has been adequate to support a finding that the issuance of the ESP will NOT be inimical to the common defense and security or to the health and safety of the public (Safety Issue 1).

- whether the application and the record of the proceeding contain sufficient information, and the review of the application by the NRC Staff has been adequate to support a finding that, 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 (Safety Issue 2).

[11] The pagination of some electronic versions of the transcripts differ from the version on ADAMS. Citations in these findings are to the transcripts as released on ADAMS.

68 Fed. Reg. at 67,489. With respect to environmental matters, the Board must determine whether the review conducted by the Commission pursuant to NEPA has been adequate. Id. The Board must also:

- Determine whether the requirements of Section 102(2)(A), (C), and (E) of NEPA and Subpart A of 10 C.F.R. Part 51 have been complied with in the proceeding (NEPA Baseline Issue 1).
- Independently consider the final balance among the conflicting factors contained in the record of the proceeding and must determine the appropriate action to be taken (NEPA Baseline Issue 2).
- Determine, after considering reasonable alternatives, whether the ESP should be issued, denied, or appropriately conditioned to protect environmental values (NEPA Baseline Issue 3).

Id.

The Commission has explained the standards that should be used in making these determinations. In CLI-05-17, the Commission held that "boards should conduct a simple 'sufficiency' review. . . ." Exelon Generation Co., LLC (Early Site Permit for Clinton ESP Site), CLI-05-17, 62 N.R.C. 5, 39 (2005). In contrast to contested proceedings in which boards must decide whether the applicant has met its burden of proof, in an uncontested mandatory hearing "the boards should decide simply whether the safety and environmental record is 'sufficient' to support license issuance." Id.

When determining whether the record is sufficient to support license issuance, "boards should inquire whether the NRC Staff performed an adequate review and made findings with reasonable support in logic and fact." Id. (footnote omitted). The NRC Staff's underlying technical and factual findings, however, are not open to board reconsideration unless, after a review of the record, a board finds the NRC Staff review inadequate or its findings insufficient. Id. at 39-40. Thus, with respect to matters not in controversy, a board is not to duplicate the

NRC Staff's review, but is to rely upon the uncontroverted testimony of the Staff and applicant, and the uncontroverted conclusions of the ACRS. Id. at 35 & n.40, quoting Statement of General Policy: Conduct of Proceedings for the Issuance of Construction Permits for Protection and Utilization Facilities for Which a Hearing is Required Under Section 189a of the Atomic Energy Act of 1954, as Amended, formerly codified at 10 C.F.R. Part 2, App. A. Further, the Commission has stated that a mandatory hearing board must narrow its inquiry to those topics or sections in NRC Staff documents that it deems most important and should concentrate on portions of the documents, if any, that do not on their face adequately explain the logic, underlying facts, and applicable regulations and guidance. See Exelon Generation Co., LLC (Early Site Permit for Clinton ESP Site), CLI-06-20, 64 N.R.C. 15, 22 (2006).

The Commission has held that licensing boards should apply these same standards when reviewing the three NEPA Baseline Issues. According to the Commission, its ruling that licensing boards should not perform a de novo review of uncontested issues "applies fully to the three NEPA baseline issues insofar as NRC Staff factual or technical judgments are concerned." Clinton, CLI-05-17, 62 N.R.C. at 44. "[W]hile NEPA demands independent environmental judgments by licensing boards ... the boards need not rethink or redo every aspect of the NRC Staff's environmental findings or undertake their own fact-finding activities." Id.

III. Findings on Safety Issues

A. Safety Issue 1

1. The Board must decide whether Dominion's Application and the record of the proceeding contain sufficient information, and the review of Dominion's Application by the NRC Staff has been adequate to support a finding that the issuance of the ESP will NOT be inimical to the

common defense and security or to the health and safety of the public. The Board's findings on this issue are provided below:

1. Common Defense and Security

2. With respect to the ESP's impact on the common defense and security, 10 C.F.R. § 100.21(f) requires that the site characteristics allow adequate security plans and measures to be developed. Dominion's Safety Testimony and Section 13.6 of the SSAR show that the characteristics of the ESP Site are such that the applicable requirements of 10 C.F.R. § 73.55 and Regulatory Guide 4.7, as well as the post-9/11 Orders, can be implemented. The ESP Site is sufficiently large to allow adequate distances between structures and the likely security boundary. The security program currently in place for the existing units at the site would continue to be met in the event new units are added. Dom. Exh. 9 (Dom. Safety Test.) at 29; Dom. Exh. 11, SSAR § 13.6.

3. Section 13.6 of the SER describes the NRC Staff's evaluation of this information. Using the criteria in 10 C.F.R. § 100.21(f), the NRC Staff identified and considered the characteristics of the ESP Site that could affect the development of adequate security plans and measures, including pedestrian land approaches, vehicular land approaches, railroad approaches, waterborne approaches, potential high ground adversary advantage areas, nearby railroad transportation routes, nearby hazardous materials facilities, nearby pipelines, and culverts that could provide a pathway into the protected areas. Staff Exh. 1 (SER) § 13.6.3. Based on this evaluation, the NRC Staff "concludes that the ESP site characteristics would allow an applicant for a COL or CP to develop adequate security plans and measures for a reactor(s) that it might construct and operate on the ESP site." Staff Exh. 1 (SER) § 13.6.4. Accordingly, the record

contains sufficient information to support a finding that granting the ESP would not be inimical to the common defense and security.

2. Public Health and Safety

4. As a general matter, a demonstration of compliance with the regulations allows a licensing board to find adequate protection to the health and safety of the public, or conversely, reasonable assurance that the health and safety of the public will not be endangered. Maine Yankee Atomic Power Co. (Maine Yankee Atomic Power Station), ALAB-161, 6 A.E.C. 1003, 1010 (1973). It is particularly appropriate to judge safety by compliance with the applicable regulations in a reactor siting proceeding, where the Commission has established specific criteria in 10 C.F.R. Part 100 for determining the acceptability of a site, which represent the Commission's judgment based on decades of experience. See Staff Exh. 15 (Wunder Test.) at 3.

5. With respect to the health and safety of the public, the NRC's safety requirements applicable to an ESP proceeding consist of the siting factors and criteria set forth in 10 C.F.R. §§ 100.20, 100.21, and 100.23. These factors and criteria encompass the radiological evaluation factors in 10 C.F.R. § 50.34(a)(1)[12] and the emergency planning provisions in 10 C.F.R. § 52.17(b)(1).[13] As discussed in Dominion's Safety Testimony, Dominion's SSAR addressed each applicable regulatory requirement, followed NRC guidance in the Review Standard and applicable Regulatory Guides, and was prepared under the control of a Quality Assurance Program. Dom. Exh. 9 (Dom. Safety Test.) at 5-6.

a. Population Density and Use Characteristics

6. 10 C.F.R. § 100.20(a) requires that the population density and use characteristics of the site environs (including the exclusion area), the population distribution, and site-related

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[12] See 10 C.F.R. § 100.21(c)(2).

[13] See 10 C.F.R. §§ 100.20(a) and 100.21(g).

characteristics be evaluated to determine whether individual as well as societal risk of potential plant accidents is low. (The emergency planning requirement in 10 C.F.R. § 100.20(a) is addressed later in this decision.) 10 C.F.R. § 100.21 contains the following related criteria that must be met:

> (a) Every site must have an exclusion area and a low population zone, as defined in § 100.3;[14]
>
> (b) The population center distance, as defined in § 100.3,[15] must be at least one and one-third times the distance from the reactor to the outer boundary of the low population zone. In applying this guide, the boundary of the population center shall be determined upon consideration of population distribution. Political boundaries are not controlling in the application of this guide;
>
> (c) Site atmospheric dispersion characteristics must be evaluated and dispersion parameters established such that:
>
> > (1) Radiological effluent release limits associated with normal operation from the type of facility proposed to be located at the site can be met for any individual located offsite; and
> >
> > (2) Radiological dose consequences of postulated accidents shall meet the criteria set forth in § 50.34(a)(1) of this chapter for the type of facility proposed to be located at the site.
>
> * * *
>
> (h) Reactor sites should be located away from very densely populated centers. Areas of low population density are, generally, preferred. However, in determining the acceptability of a particular site located away from a very densely populated center but not in an area of low density, consideration will be given to safety, environmental, economic, or other factors, which may result in the site being found acceptable.

10 C.F.R. § 100.21(a)-(c), (h).

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[14] An exclusion area is defined in 10 C.F.R. § 100.3 as that area surrounding the reactor, in which the reactor licensee has authority to determine all activities including the exclusion or removal of personnel and property from the area. A low population zone ("LPZ") is defined in 10 C.F.R. § 100.3 as that area immediately surrounding the exclusion area which contains residents, the total number and density of which are such that there is a reasonable probability that appropriate protective measures could be taken in their behalf in the event of a serious accident.

[15] As defined in 10 C.F.R. § 100.3, the population center distance means the distance from the reactor to the nearest boundary of a densely populated center containing more than about 25,000 residents.

(i) Exclusion Area

7. For the ESP Site, the exclusion area is defined as the perimeter of a 5,000-ft-radius circle from the center of the previous, abandoned North Anna Unit 3 containment. This is the same as the exclusion area for the two existing nuclear units located on the NAPS site. There are no residents in this exclusion area. Dom. Exh. 9 (Dom. Safety Test.) at 9; Dom. Exh. 11, SSAR § 2.1.1.3 and Figure 2.1-1; Staff Exh. 1 (SER) at 2-7 to 2-8.

8. As discussed in Section 2.1.2 of RS-002, it is not necessary for an ESP applicant to demonstrate control of the exclusion area prior to issuance of an ESP. Rather, there must be reasonable assurance that the applicant would have such control prior to commencing activities allowed by 10 C.F.R. § 52.25. Staff Exh. 14 (RS-002) at 2.1.2-2.

9. Currently, Virginia Electric and Power Company ("Virginia Power"), which is an affiliate of Dominion, controls all of the land within the NAPS site boundary and exclusion area. Dominion therefore cannot perform any activity allowed by 10 C.F.R. § 52.25 without first entering into an agreement with Virginia Power, with the prior approval of the Virginia State Corporation Commission, to purchase or lease the ESP Site. As discussed in Sections 2.1.1.2 and 2.1.2.1of the SSAR, Dominion has committed that any such agreement or conveyance documents would provide for mutual use of the NAPS site as a single exclusion area and single restricted area for all nuclear units within the NAPS property, including the new units located within the ESP Site. Dom. Exh. 9 (Dom. Safety Test.) at 9; Dom. Exh. 11, SSAR at 2-2-2 to 2-2-3; Staff Exh. 1 (SER) at 2-6. ESP Condition 1 requires that this commitment be fulfilled prior to the commencement of construction, and therefore provides reasonable assurance that Dominion would have control of the Exclusion Area prior to commencing construction. Staff Exh. 1 (SER) at 2-7.

(ii) Population Density, Low Population Zone, and Population Centers

10. Dominion conducted an evaluation of the existing and projected future population densities, including transient populations, averaged over any radial distance out to 20 miles from the ESP Site. Dom. Exh. 9 (Dom. Safety Test.) at 10. Dominion determined that these population densities would not exceed 500 persons per square mile at the time of initial site approval and within about 5 years thereafter, and would not exceed 1,000 persons per square mile over the life of the new units. Id.; Dom. Exh. 11, SSAR § 2.1.3.6. The results of this evaluation meet the population density guidelines of Regulatory Guide ("RG") 4.7, "General Site Suitability Criteria for Nuclear Power Stations," Rev. 2, April 1998. Dom. Exh. 9 (Dom. Safety Test.) at 10.

11. The Staff compared and verified Dominion's population data against U.S. Census Bureau data, and determined that Dominion's population projections are reasonable. Staff Exh. 1 (SER) at 2-11 to 2-12. The Staff concluded that Dominion has provided acceptable description of current and projected populations densities in and around the site, and that these densities are within NRC guidelines. Id. at 2-13.

12. The LPZ for the ESP Site is defined as a 6-mile radius circle centered at the North Anna Unit 1 containment building, which is the same area as the LPZ for the two existing units at NAPS. Dom. Exh. 9 (Dom. Safety Test.) at 10; Dom. Exh. 11, SSAR Figure 2.1-2. The resident and transient population within the LPZ based on the year 2000 census was 16,705 with a projected increase to 56,588 by the year 2065. Dom. Exh. 9 (Dom. Safety Test.) at 10; Dom. Exh. 11, SSAR at 2-2-9. Recreational use of Lake Anna, which falls primarily within the LPZ, is the greatest contributor to the transient population with a total peak daily usage conservatively estimated to be less than 11,270. Id.; Dom. Exh. 11, SSAR § 2.1.3.3.1 and Table 2.1-2. The

only school in the LPZ is an elementary school located 5.7 miles to the north-northeast of the ESP Site. Dom. Exh. 9 (Dom. Safety Test.) at 10; Dom. Exh. 11, SSAR § 2.1.3.4 and Table 2.1-3. Considering the available road network leading from the LPZ, together with the availability of private as well as public vehicles, there is reasonable assurance that the affected populace could be evacuated in a timely manner in the event of an accident. Dom. Exh. 9 (Dom. Safety Test.) at 27; Dom. Exh. 11, SSAR § 2.1.3.4.; Staff Exh. 1 (SER) at 2-13.

13. The nearest population center with more than 25,000 residents is the city of Charlottesville, with a closest point to the site of 36 miles. Dom. Exh. 9 (Dom. Safety Test.) at 10-11; Dom. Exh. 11, SSAR § 2.1.3.5. This meets the requirement in 10 C.F.R. § 100.21(b) that the population center distance must be at least one and one third times the distance from the reactor to the outer boundary of the LPZ (8 miles for the North Anna ESP Site). Dom. Exh. 9 (Dom. Safety Test.) at 11; Staff Exh. 1 (SER) at 2-13. The only town within 10 miles of the site is Mineral, Virginia, which is projected to have a population of less than 10,000 in 2065. Dom. Exh. 9 (Dom. Safety Test.) at 11.

(iii) Compliance of EAB and LPZ with Dose Criteria

14. In accordance with 10 C.F.R. § 100.21(c)(2), radiological dose consequences of postulated accidents must meet the criteria in 10 C.F.R. § 50.34(a)(1) for the type of facility proposed to be located at a site. Specifically, 10 C.F.R. § 50.34(a)(1)(ii)(D) requires that accident doses calculated for an individual at the exclusion area boundary ("EAB") and LPZ not exceed 25 rem total effective dose equivalent ("TEDE").

15. To analyze the suitability of the ESP Site, Dominion analyzed a robust and conservative set of surrogate design basis accidents ("DBAs") representative of the reactor designs on which the PPE is based. Dom. Exh. 9 (Dom. Safety Test.) at 11. The set of accidents selected focused on

three light water reactor ("LWR") designs: the AP1000, the ABWR, and the ESBWR. Id. These designs are standard designs that have well-established bases for postulated accident analyses and are expected to bound the accident radiological consequences of the reactors considered for the ESP Site. Id.; Staff Exh. 2 (SER Supp.) at 15-6.

16. To determine the DBA doses, the analyses used short-term accident atmospheric dispersion factors (χ/Q) calculated using the methodology of RG 1.145, "Atmospheric Dispersion Models for Potential Accident Consequence Assessments at Nuclear Power Plants," Revision 1, November 1982; and site-specific meteorological data. Staff Exh. 1 (SER) at 15-5; Dom. Exh. 9 (Dom. Safety Test.) at 11. Consistent with 10 C.F.R. § 50.34, Dominion expressed the accident doses as TEDE, calculated based on the dose conversion factors in Federal Guidance Report 11, "Limiting Values of Radionuclide Intake and Air Concentration and Dose Conversion Factors for Inhalation, Submersion, and Ingestion," EPA-520/1-88-020 (1988); and in Federal Guidance Report 12 "External Exposure to Radionuclides in Air, Water, and Soil," EPA-402-R-93-081 (1993). Dom. Exh. 9 (Dom. Safety Test.) at 12; Dom. Exh. 11, SSAR § 15.2. Because the ABWR design certification document presents whole body and thyroid doses, an equivalent TEDE value was estimated by multiplying the thyroid dose by 0.03 and adding the product to the whole body dose in accordance with RG 1.183, "Alternative Radiological Source Terms for Evaluating Design Basis Accidents at Nuclear Power Reactors" (July 2000). Dom. Exh. 9 (Dom. Safety Test.) at 12; Dom. Exh. 11, SSAR § 15.4.

17. For the AP1000 and ABWR accidents, Dominion calculated site-specific doses by multiplying the design certification doses of each reactor by the ratio of the site χ/Qs to the design certification χ/Qs of that reactor. Dom. Exh. 9 (Dom. Safety Test.) at 12. The doses for the ESBWR design, which has not yet been certified by the NRC, were calculated based on

activity releases, including a 25 percent margin to allow for uncertainty. Although emergency safety features are expected to prevent core damage and mitigate releases of radioactivity, the loss-of-coolant accidents ("LOCA") analyzed for each reactor presume substantial core damage and the release of significant amounts of fission products. Id. As expected, the exposure from a LOCA is most limiting, but is less than half the acceptance criteria. Id. The calculated radiological doses at the EAB and LPZ boundary meet the regulatory requirements in 10 C.F.R. § 50.34(a)(1) for the proposed ESP Site. Id.; Dom. Exh. 11, SSAR § 15.4.

18. The NRC Staff reviewed Dominion's selection of DBAs and found that they were consistent with the DBAs listed in the Standard Review Plan and RG 1.183, and acceptable for evaluating compliance with the dose consequence evaluation factors specified in 10 C.F.R. § 50.34(a)(1). Staff Exh. 2 (SER Supp.) at 15-5. The Staff also reviewed Dominion's site specific χ/Q values and performed an independent evaluation of atmospheric dispersion in accordance with the guidance provided in Section 2.3.4 of RS-002. Id. at 15-6. (See also Finding 45 infra). In addition, the NRC Staff verified that the design specific source terms provided by Dominon were consistent with those evaluated (or being evaluated) in the design certification reviews. Id. at 15-8. The NRC Staff performed confirmatory dose calculations for the ESBWR and confirmed that the doses calculated by Dominion are correct. Id. at 15-9. Because Dominion simply used the ratio of the site specific χ/Q values to the postulated design χ/Q values for the AP1000 and ABWR designs that have been certified, the NRC Staff determined that an independent calculation for these designs was neither useful nor necessary. Id. Based on this review, the NRC Staff has determined that the proposed distances to the EAB and LPZ outer boundary are adequate to provide reasonable assurance that the radiological consequences of

DBAs will be within the radiological consequence evaluation factors in 10 C.F.R. § 50.34(a)(1). Id. at 15-10.

b. Radiological Effluent Releases Associated with Normal Operations

19. 10 C.F.R. § 52.17(a)(1)(iv) provides that an ESP application should describe the anticipated maximum levels of radiological effluents that each facility will produce during normal operation. In addition, 10 C.F.R. § 100.21(c)(1) requires evaluation of site atmospheric dispersion characteristics and establishment of dispersion parameters such that radiological effluent release limits associated with normal operations from the type of facility proposed to be located at the site can be met for any individual located offsite.

20. Dominion derived PPE values for gaseous and liquid effluents by using the most conservative release values for each radionuclide for the reactor design where the information was available. The PPE source term was derived for the ABWR, the ESBWR, the AP1000 and the ACR-700. Dom. Exh. 11, SSAR § 1.3.1; Tr. 311 (Stoetzel).

21. In Revision 9 of the Environmental Report, Dominion reduced the liquid effluent source term for tritium from 3100 curies per year per unit (the value initially attributed to the ACR-700) to 850 curies per year per each new unit. This value was reduced to ensure that the tritium concentration in Lake Anna would not exceed the EPA drinking water standard of 20,000 picocuries per liter. Tr. 312 (Stoetzel).

22. In addition, the NRC Staff independently evaluated an additional 216 curies per year of tritium that could be released to the atmosphere from the Unit 3 wet cooling towers. The Staff calculated this value by multiplying the projected average annual tritium concentration in Lake

Anna (9400 picocuries per liter) by the evaporation rate for the Unit 3 cooling tower. Tr. 312 (Stoetzel).

23. Dominion and the NRC Staff used the LADTAP II computer program to calculate liquid pathway doses to the maximally-exposed individual on a per unit basis, for the following activities: eating fish and invertebrates caught near the discharge point; drinking water from Lake Anna; and boating, swimming and use of shoreline for recreational purposes. Tr. 463-64 (Stoetzel). Staff Exh. 2 (SER Supp.) at 11-5.

24. The PPE source term was used as the input into the computer program. Other parameters used as input included the effluent discharge rate, the dilution factor for the discharge, and transit time to the receptor locations as provided in Dominion's Environmental Report. The Staff reviewed the parameters for reasonableness. The Staff then performed independent dose estimates and compared them to Dominion's estimates. Tr. 464 (Stoetzel); Staff Exh. 2 (SER Supp.) at 11-5.

25. The Staff compared the liquid pathway doses to the maximally-exposed individual on a per unit basis against the design objectives in 10 C.F.R. Part 50, Appendix I. With respect to the liquid effluent pathway, the maximum annual total body dose was estimated to be about 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. Id.

26. Dominion and the Staff used the GASPAR II computer program to calculate the doses from gaseous effluents on a per unit basis to the maximally-exposed individual at (1) the nearest site boundary; (2) the nearest vegetable garden; (3) the nearest resident; and (4) the nearest meat cow. Doses from the milk pathway were not calculated because there are no milk cows or goats

located within a five mile radius of the ESP Site. Tr. 464-65 (Stoetzel); Staff Exh. 2 (SER Supp.) at 11-3.

27. Other inputs to the program included meat and vegetable production rates, atmospheric dispersion factors, ground deposition factors, receptor locations and consumption factors. This information was provided by Dominion in its Environmental Report. Tr. 465 (Stoetzel). Dominion derived the atmospheric dispersion parameters in accordance with the guidance in RG 1.111 using the NRC-approved XOQDOQ model. Staff Exh. 1 (SER) at 2-52; Staff Exh. 6 at 19 (response to safety question 24); Dom. Exh. 11, SSAR § 2.3.5; Dom. Exh. 9 (Dom. Safety Test.) at 15. The NRC Staff reviewed the input parameters for reasonableness, performed an independent calculation of the doses, and in addition estimated the dose from the projected tritium release from the Unit 3 wet cooling tower.[16] The NRC Staff then compared its calculated doses to 10 C.F.R. Part 50 Appendix I design objectives. Tr. 465 (Stoetzel). The gaseous effluent doses were determined to be well within the Appendix I design objectives. Tr. 468-69 (Stoetzel); Staff Exh. 2 (SER Supp.) at 11-4.

28. In addition, the estimated total doses from the liquid and gaseous effluents to the maximally-exposed individual from both the current operating units and the two proposed units were shown to be well within the regulatory standards of 40 C.F.R. Part 190. The calculated whole body dose from the two existing units and two new units is 6.8 millirem per year compared with the 25 millirem per year limit on whole body dose in 40 C.F.R. Part 190. The calculated dose to the thyroid from all all four units is 27 millirem per year, compared with 40

[16] The doses from tritium released from the Unit 3 wet cooling tower did not contribute significantly to the dose. The doses from that pathway were less than 10 percent of the dose from the reactor gaseous effluents. Tr. 468 (Stoetzel).

C.F.R. Part 190 limit of 75 millirem per year. Tr. 469-71 (Stoetzel); Staff Exh. 2 (SER Supp.) at 11-4, 11-6; Staff Exh. 6 at 75 (response to safety question 85).

29. Dominion also estimated bounding gaseous effluent radionuclide concentrations for receptors assumed to be located at the Exclusion Area Boundary, demonstrating compliance with the gaseous effluent release concentration limits in 10 C.F.R. Part 20. Dom. Exh. 11, ER at 3-5-133 and 3-5-142 (Table 5.4-7); Staff Exh. 2 (SER Supp.) at 11-4. Dominion likewise estimated bounding liquid effluent radionuclide concentrations for receptors assumed to be located at the end of the discharge canal, demonstrating compliance with the liquid effluent release concentration limits in 10 C.F.R. Part 20. Dom. Exh. 11, ER at 3-5-133 and 3-5-139 (Table 5.4-6); Staff Exh. 2 (SER Supp.) at 11-5. The NRC Staff performed an independent evaluation and confirmed that the Part 20 limits would be met. Staff Exh. 2 (SER Supp.) at 11-4 and 11-5; Staff Exh. 6 (response to safety question 86); Staff Exh. 7; Tr. 503 (Dehmel).

30. As previously indicated, the potential concentration of tritium in Lake Anna was also considered. For initial licensing of Units 1 and 2, a predictive model was developed to evaluate the buildup of tritium in the lake. This methodology is documented in North Anna's Updated Final Safety Analysis Report. Tr. 403 (Tarantino). The measurements of tritium concentrations in Lake Anna under the NAPS Radiological Environmental Monitoring Program ("REMP") program are within the model's prediction. Tr. 403, 411 (Tarantino). Dominion used this same model to predict the concentrations of tritium in Lake Anna that would result with additional units. Tr. 406 (Jha). With the PPE limit of 850 Ci per unit per year on tritium in liquid effluent, operation of the current Units 1 and 2 and the proposed Units 3 and 4 would result in an estimated tritium concentration in Lake Anna of approximately 9400 picocuries per liter, which is less than half of the EPA drinking water standard. Tr. 312 (Stoetzel).

31. The Board inquired whether the PPE limit on tritium in liquid effluent implied that the ACR-700 had been abandoned as an option. Tr. 331. As Dominion testified, however, the ESP does not approve or disapprove any specific design for the site. Rather, it is a determination that the site is acceptable for technologies that fall within a defined PPE. Tr. 391 (Smith). Dominion also testified that the 3,100 Ci liquid effluent source term for the ACR-700 represents more a characterization of the amount of tritium that would be produced in the heavy water colandria, rather than the amount of tritium that would be actually released. Tr. 391-94 (Smith). Because the ACR-700 is a new design (different from existing CANDUs) and not in operation, there is no actual data regarding tritium in liquid effluent. In the professional opinion of Dominion's witness Mr. Smith, the Director responsible for the ESP project and a nuclear engineer with over 30 years experience,[17] an applicant for a combined license could potentially be able to show that the actual tritium and liquid effluents for the ACR-700 would be far lower. Tr. 421 (Smith).

32. The Board also explored whether there might be existing radiological contamination of the groundwater that might result in an unmonitored contribution to dose from the operating units. In response to the Board's request for data, Dominion provided data recently collected as part of a Groundwater Protection Initiative ("GPI") that Dominion has implemented in response to operating experience at other plants. Dom. Exh. 1, Att. 6 (ASLB Safety Question No. 48 Response, dated April 17, 2007);[18] Tr. 267-68 (Tarantino); Dom. Exh. 12, Slide 13. These data included measurements of tritium in the four mat sumps under the basemat of the existing units, as well as data from the Unit 2 valve pit. The tritium concentrations in groundwater that Dominion has measured in these and other locations have ranged from less than 166 picocuries

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[17] See Dom. Exh. 9 (Dom. Safety Test.) at 2, and Summary of Qualifications attached thereto.

[18] Attachment 6 to Dom. Exh. 1 contains additional data that Dominion provided in an April 17, 2007 correction to its original response.

per liter to 2,080 picocuries per liter. Tr. 414 (Tarantino). All of the measurements are below both the EPA drinking water standard and below the concentration of tritium currently found in Lake Anna.[19] Tr. 268 (Tarantino); Tr. 387 (Smith).

33. These tritium concentration levels are not indicative of significant leaks such as those relating to spent fuel pool leakage at other plants, which have been far higher. Tr. 453, 455 (Breeden). Rather, the measured tritium concentrations may simply be attributable to the use of lake water in fire mains and service water. Tr. 453 (Breeden). See also Tr. 447 (Tarantino). It is also possible that the mat sumps may be acting as a hydrological sink, pulling lake water underneath the plant. Tr. 454 (Breeden, Hintz). The current lake concentration is indeed high enough that it logically could be the source of measured tritium concentrations. Tr. 455 (Breeden). Dominion is in the process of installing 5 monitoring wells down-gradient of the existing units to determine what these indications mean. Tr. 454-55 (Breeden).

34. The Board concludes that the small levels of tritium measured under the existing units would not affect the adequacy of Dominion's or the NRC Staff's dose calculations. The NRC Staff testified that this information does not change any of the conclusions in the Safety Evaluation Report. Tr. 533 (Dehmel). The groundwater under the existing units flows toward and into the lake (See Tr. 212 (Bagchi); Tr. 257 (Matthews); Tr. 387 (Smith)), and all tritium measurements in the groundwater are at concentrations below lake levels. Thus, the small levels of tritium measured under the existing units cannot result in any increased dose to a member of the public.

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[19] REMP measurements for tritium in the lake using the most recent 5-year period show 3,000 picocuries per liter, which equates to approximately 15 percent of the EPA drinking water standard. Tr. 410 (Tarantino).

c. Nature and Proximity of Man-Made Hazards

35. 10 C.F.R. § 100.20(b) requires that the nature and proximity of man-made hazards (*e.g.*, airports, dams, transportation routes, military and chemical facilities) be evaluated to establish site parameters for use in determining whether a plant design can accommodate commonly occurring hazards, and whether the risk of other hazards is very low. Pursuant to 10 C.F.R. § 100.21(e), potential hazards associated with nearby transportation routes and industrial and military facilities must be evaluated and site parameters established to show that such potential hazards will pose no undue risk to the type of facility proposed to be located at the site.

36. Because the ESP Site is located at an existing nuclear power station, off-site hazards have already been identified for NAPS and were confirmed for the ESP Site. Staff Exh. 1 (SER) at 2-17; Dom. Exh. 9 (Dom. Safety Test.) at 13. There are no military bases, missile sites, manufacturing plants, chemical plants, chemical or other storage facilities, airports, major railroad lines, major water transportation, or oil and gas pipelines located within 5 miles of the ESP Site. Dom. Exh. 9 (Dom. Safety Test.) at 13; Dom. Exh. 11, SSAR § 2.2.1. RS-002, Section 2.2.1-2.2.2, states that facilities and activities in close proximity warrant attention and those within 5 miles need to be reviewed. Staff Exh. 14 (RS-002) at 2.2.1-2. There are no substantial industrial activities within 5 miles of the ESP Site. Future major industrial developments are more likely to be concentrated along the I-95 corridor rather than within 5 miles of the site. Dom. Exh. 9 (Dom. Safety Test.) at 13; Dom. Exh. 11, SSAR § 2.2.2.1.

37. The NRC Staff evaluated the information that Dominion provided on man-made hazards and also evaluated information that the NRC Staff obtained from a site visit and from available reference material. Based on its evaluation, including the information obtained independently,

the NRC Staff concluded that all potentially hazardous activities in the vicinity of the ESP Site have been identified. Staff Exh. 1 (SER) at 2-16 to 2-17.

38. Based on lack of proximity to the ESP Site, no offsite hazards required further evaluation except aircraft hazards associated with air traffic routes. Dom. Exh. 9 (Dom. Safety Test.) at 13. Dominion analyzed aircraft hazards in accordance with RS-002, Section 3.5.1.6. Id. One civil airway and three military training routes pass near the ESP Site. The centerline of the civil airway is 5.5 miles west of the ESP Site, and the corridor width is 4 miles on either side of the centerline. The Federal Aviation Administration ("FAA") station at Richmond International Airport has characterized the airway as "not heavily used" and estimates traffic at no more than 200 aircraft per day (73,000 aircraft per year). The centerlines of the three military training routes are 1 mile south of the ESP Site, and the corridor width is 10 miles across. The combined number of flights using these three routes has remained fairly constant over time (6,000 aircraft per year), and each flight typically consists of 1 or 2 aircraft, or on rare occasion 4 aircraft. Id. at 13 to 14; Dom. Exh. 11, SSAR § 2.2.2.6.2. Applying the methodology of RS-002 Section 3.5.1.6, and using a conservative estimate of the facility area as 0.013 square miles, Dominion determined that aircraft accident probabilities are within the guidance acceptance criteria of less than 10^{-7} per year. Dom. Exh. 9 (Dom. Safety Test.) at 14; Dom. Exh. 11, SSAR § 2.2.3.2.2.

39. The NRC Staff independently verified Dominion's assessment of aircraft hazards. The NRC Staff also concluded that the probability of an accident having potential for radiological consequence in excess of the exposure criteria in 10 C.F.R. § 50.34(a)(1) is less than 10^{-7} per year. Staff Exh. 1 (SER) at 3-4.

d. Physical Characteristics of the Site (Seismology, Meteorology, Geology, and Hydrology)

(i) Meteorology -- Local And Regional Climatology

40. As specified in 10 C.F.R. § 100.20(c) and 10 C.F.R. § 100.21(d), the meteorological characteristics of a proposed site are to be considered in determining the acceptability of a site for commercial power reactors. To characterize the regional and local climatology, including extreme weather phenomena, pertinent to the ESP Site, Dominion acquired data reported by the National Weather Service ("NWS") at the Richmond, Virginia first-order weather station and from a network of cooperative observer stations, as compiled and summarized by the National Climatic Data Center ("NCDC") and its predecessor agencies. Consistent with the guidelines provided in RS-002, Sections 2.3.1 and 2.3.2, information on meteorological conditions at the ESP Site was collected from a variety of sources, including the NWS stations, NCDC's Storm Events database for Virginia, the National Oceanic and Atmospheric Administration Coastal Services Center, and the National Hurricane Center. Dom. Exh. 9 (Dom. Safety Test.) at 14; Dom. Exh. 11, SSAR § 2.3.1.1.

41. In addition to data from the nearby climatological observation stations, data collected from the meteorological monitoring system at the existing NAPS units was also used to characterize local meteorological conditions. Dom. Exh. 9 (Dom. Safety Test.) at 14. Because the ESP Site is within the existing NAPS site, the meteorological parameters (i.e., wind speed and wind direction) collected by the onsite primary meteorological tower are representative of the ESP Site and are considered appropriate for use in describing local meteorological conditions. Id.; Dom. Exh. 11, SSAR § 2.3.2.1.

42. Using the climatological data collected and guidance provided in well-known industry standards, Dominion determined the meteorological conditions that would be used as the design

and operating bases for proposed units at the ESP Site. Id. at 15. The site characteristics developed included design basis extreme wind and winter precipitation load conditions, tornado loads, ultimate heat sink ("UHS") meteorological conditions, and air temperature and humidity values. Id. To establish these site characteristics, Dominion considered the most severe weather phenomena and utilized accepted industry practices consistent with the guidance RS-002, Section 2.3.1. Id.

43. In accordance with the guidance provided in RS-002, Section 2.3.2, Dominion also evaluated the potential influence of any new units at the ESP Site on local meteorological conditions. Dom. Exh. 9 (Dom. Safety Test.) at 15. It was determined that operation of the proposed cooling tower systems may result in an increase in the local ambient air temperature or moisture content at the NAPS site, but would not affect ambient atmospheric and ground temperatures beyond the NAPS site boundary. Id.; Dom. Exh. 11, SSAR § 2.3.2.3; Staff Exh. 2 (SER Supp.) at 2-2 to 2-3. This potential influence would be considered as part of detailed engineering for any new units at the ESP Site. Dom. Exh. 9 (Dom. Safety Test.) at 15; Dom. Exh. 11, SSAR § 2.3.2.3.

44. The local meteorological data were also used to develop site atmospheric dispersion characteristics as required by 10 C.F.R. § 100.21(c). Based on guidance provided in RS-002, Section 2.3.4, and using the NRC-sponsored PAVAN computer model, Dominion determined the relative ground level air concentrations (χ/Qs) at the EAB and LPZ for potential accidental releases of radioactive material. Dom. Exh. 9 (Dom. Safety Test.) at 15; Dom. Exh. 11, SSAR § 2.3.4.

45. The NRC Staff evaluated the applicability of the PAVAN code and concluded that no unique topographical features preclude its use for the ESP Site. The NRC Staff also reviewed

Dominion's input to the PAVAN code, including the assumptions concerning plant configuration and release characteristics and the appropriateness of the meteorological data input. The NRC Staff found that Dominion made conservative assumptions by ignoring building wake effects and treating all releases as ground releases. The NRC Staff made an independent evaluation of the resulting atmospheric diffusion estimates by running the PAVAN code itself and obtaining similar results. Staff Exh. 1 (SER) at 2-50. The NRC Staff therefore concluded that Dominion's atmospheric dispersion estimates for accident releases are appropriate for the assessment of consequences from radioactive releases for postulated accidents in accordance with 10 C.F.R. § 100.21. Id. at 2-51.

46. In addition, to estimate the radiological effluent release limits due to normal operation of new units at the ESP Site, Dominion calculated the χ/Q and relative deposition ("D/Q") values due to routine releases utilizing the NRC-sponsored XODQOD computer model and the assumptions outlined in Revision 1 of RG 1.111, "Methods for Estimating Atmospheric Transport and Dispersion of Gaseous Effluents in Routine Releases for Light-Water-Cooled Reactors," July 1977, consistent with the guidelines in RS-002, Section 2.3.5. Dom. Exh. 9 (Dom. Safety Test.) at 15 to 16; Dom. Exh. 11, SSAR § 2.3.5.

47. The NRC Staff evaluated the applicability of the XOQDOQ model and concluded that no unique topographical features preclude its use for the ESP Site. The NRC Staff also reviewed Dominion's input to the computer code, including the assumptions concerning plant configuration and release characteristics and the appropriateness of the meteorological data input. The NRC Staff found that Dominion had made conservative assumptions by treating all releases as ground-level releases. The NRC Staff made an independent evaluation of the resulting atmospheric diffusion estimated by running the XOQDOQ model and obtaining similar

results. Staff Exh. 1 (SER) at 2-55. The NRC Staff therefore concluded that Dominion had provided the information required by 10 C.F.R. § 100.21(c)(1), and that Dominion's characterization of long-term atmospheric transport and diffusion conditions is appropriate for use in demonstrating compliance with the numerical guidelines in 10 C.F.R. Part 50, Appendix I. Id. at 2-57.

(ii) Hydrology

48. 10 C.F.R. §§ 100.20(c)(3) and 100.21(d) require consideration of hydrologic characteristics and a determination that any potential threat from such characteristics will pose no undue risk to the facility. As required by Section 2.4.1 of RS-002, Dominion provided a description of the general hydrology at the ESP Site in Section 2.4.1 of the SSAR, which the NRC Staff found sufficient in SER Section 2.4.1 (see Dom. Exh. 9 (Dom. Safety Test.) at 16), and then evaluated the following topics specified in RS-002.

(A) Flooding

49. The hydrologic characteristics to be considered in determining the acceptability of a proposed site, as specified in 10 C.F.R. §§ 100.20(c)(3) and 100.21(d), require a determination of the probable maximum flood ("PMF") water level conditions at the site, including an evaluation of the coincident wind-generated wave conditions that could occur with the PMF. For the ESP Site, Dominion performed a PMF analysis in accordance with RS-002, Sections 2.4.2 and 2.4.3; and the procedures outlined in ANS/ANSI-2.8-1992, "Determining Design Basis Flooding at Power Reactor Sites," July 1992. Dom. Exh. 9 (Dom. Safety Test.) at 16. Dominion determined the PMF by estimating the runoff from the probable maximum precipitation ("PMP") for the Lake Anna drainage area, routing the runoff hydrograph through the watershed and Lake Anna, and computing the resulting peak water level at the site. Id. The PMF elevation also took into consideration the wind setup and the runup of wind-generated waves at the site location. Id.

Based on this analysis, Dominion calculated a PMF elevation of 267.39 ft msl for Lake Anna at the ESP Site. Id. The NRC Staff performed its own independent analysis and calculated a PMF elevation of 270 msl. Staff Exh. 1 (SER) at 2-84. The NRC Staff conservatively established this elevation as the site characteristic. Staff Exh. 2 (SER Supp.) at A-19. This site characteristic is below the minimum proposed site grade elevation of 271.0 ft msl. Dom. Exh. 9 (Dom. Safety Test.) at 17. Therefore, since the ESP Site grade elevation is above the PMF level, all above-grade, safety-related structures, systems, and components of the new units would be located above the design basis flooding elevation. Id.; Dom. Exh. 11, SSAR, §§ 2.4.2.2 and 2.4.3.

(B) Safety Heat Sink

50. As discussed in RS-002 Section 2.4.4, one of the factors to be considered is the potential for seismically-induced dam failures. The ESP Site is located adjacent to Lake Anna, which was created to supply water to the existing NAPS units, and is approximately 5 miles upstream of the North Anna Dam. No other dams exist on the North Anna River, either upstream or downstream of the ESP Site. The only impoundments in the area are small farm ponds and two small recreational lakes – Lake Louisa and Lake Orange – that are located on small tributaries to the North Anna River, and whose failures would not produce any measurable effect on Lake Anna, the North Anna Dam, or any safety-related systems. Dom. Exh. 9 (Dom. Safety Test.) at 17; Dom. Exh. 11, SSAR § 2.4.4.

51. The Staff consulted U.S. Geological Service ("USGS") maps to independently verify Dominion's information and concluded that no dams of significant storage , the failure of which could endanger the North Anna dam, exist upstream. Staff Exh. 1 (SER) at 2-87. The Staff also independently consulted the National Inventory of Dams and determined that, even if all of the water stored in Lake Louisa and Lake Orange arrived in Lake Anna coincident with the PMF,

the ESP Site would not be flooded. Id. at 2-88. The Staff concluded that Dominion had provided sufficient information pertaining to dam failures. Id. at 2-89.

52. The design of the North Anna Dam complies with the requirements applicable to Seismic Class I structures, as discussed in the NAPS UFSAR; therefore, a seismically induced failure of the dam is not credible. Dom. Exh. 9 (Dom. Safety Test.) at 17; Dom. Exh. 11, SSAR § 2.4.4. Moreover, new units would not rely upon Lake Anna as a source of safety-related cooling water. Dom. Exh. 9 (Dom. Safety Test.) at 17. Rather, any new unit would employ either a UHS consisting of a mechanical draft cooling tower over a buried water storage basin or other water storage or passive cooling features required by the reactor design. Id.; Staff Exh. 1 (SER) at 2-89. Therefore, no safety-related structures or systems of any new units would be adversely affected by the loss of water in Lake Anna due to dam failure, even if such a failure were credible. Dom. Exh. 9 (Dom. Safety Test.) at 17; Dom. Exh. 11, SSAR § 2.4.4.

53. To meet the requirements in 10 C.F.R. § 100.23, RS-002 Section 2.4.11 provides that the site hydrological characteristics that may reduce or limit the available supply of cooling water for normal operation, anticipated operational occurrences, and emergency conditions should be considered. Using a water budget analysis, Dominion estimated the minimum lake level with the new units to be 244.2 ft msl. Dom. Exh. 9 (Dom. Safety Test.) at 18; Dom. Exh. 11, SSAR § 2.4.11.4. The NRC Staff estimated this level to be 242.9 ft msl using more conservative assumptions. Staff Exh. 2 (SER Supp.) at 2-6. Both estimates are considered acceptable from a safety perspective because they are above the shutdown elevation of 242 ft msl for both the ESP Unit 3 and NAPS Units 1 and 2, and thus would not result in frequent and sudden reliance on a UHS. Id. Further, the water level in Lake Anna would not affect the ability of the UHS to provide emergency cooling. Id. at 2-7.

(C) Ice effects

54. In accordance with RS-002 Section 2.4.7, Dominion conducted an investigation of ice effects at the ESP Site, including historical ice conditions at the NAPS site, and the potential for ice build-up at the intake structure and on the surface of Lake Anna. Dom. Exh. 9 (Dom. Safety Test.) at 18. The intakes and associated pumps for the new units would not be safety-related facilities. Id.; Dom. Exh. 11, SSAR § 2.4.7.5. In addition, the cooling water system designs for the proposed new units would rely on separate normal cooling and emergency cooling water systems with no system interconnections or inter-system reliance. Dom. Exh. 9 (Dom. Safety Test.) at 18. Thus, these systems would not be affected by ice conditions in Lake Anna. Id.; Dom. Exh. 11, SSAR § 2.4.7.2. Furthermore, emergency cooling and service water needed by any new plant design to maintain the new units in a safe mode would be supplied by a UHS separate from Lake Anna. Dom. Exh. 9 (Dom. Safety Test.) at 18. Therefore, no safety-related facilities would be affected by ice conditions in Lake Anna. Id.; Dom. Exh. 11, SSAR §§ 2.4.7.4 and 2.4.7.5.

55. The NRC Staff independently verified certain hydrological characteristics provided by Dominion. Staff Exh. 1 (SER) at 2-104. The NRC Staff independently estimated the likely thickness of surface ice that may form near intake structures. Id. The NRC Staff concluded that Dominion has provided sufficient information pertaining to ice effects and has therefore met the requirements concerning ice effects with respect to 10 C.F.R. § 52.17(a) and 10 C.F.R. § 100.20(c). Id. at 2-108.

(D) Channel Diversions

56. As discussed in RS-002 Section 2.4.9, the potential for flooding adversely affecting the supply of cooling water due to channel diversion or realignment needs to be considered when

evaluating the acceptability of a proposed site to meet the requirements in 10 C.F.R. § 100.20(c). Historical information reviewed by Dominion indicates that the North Anna River has not had a major change of course in recent history and, therefore, the possibility of an upstream diversion of the North Anna River is considered extremely remote. Dom. Exh. 9 (Dom. Safety Test.) at 19; Dom. Exh. 11, SSAR § 2.4.9.

57. The NRC Staff reviewed this information, developed a basic understanding of the geomorphology of the region during its site visit, and agreed that channel diversion above Lake Anna is unlikely. Staff Exh. 1 (SER) at 2-113. The NRC Staff concluded that Dominion had provided sufficient information pertaining to the channel diversions, and had met the requirements regarding channel diversions with respect to 10 C.F.R. § 52.17(a), 10 C.F.R. § 100.20(c), and 10 C.F.R. § 100.21(d). Id.

(E) Low Water Considerations

58. As discussed in RS-002 Section 2.4.11, site hydrological characteristics that may reduce or limit the available supply of cooling water supply for safety-related structures, systems, or components ("SSC") should be evaluated. Dominion calculated a minimum water surface elevation of 244.2 msl. Dom. Exh. 11, SSAR at 2-2-135 Although Lake Anna would provide make-up water for the cooling towers proposed for the new units, the Lake would not directly supply cooling water to any safety-related facilities and would not serve as the UHS. Thus, low water levels do not pose a safety-related risk to the new units. Dom. Exh. 9 (Dom. Safety Test.) at 19; Dom. Exh. 11, SSAR § 2.4.11.

59. The NRC Staff performed an independent analysis of the Lake Anna water budget under critical conditions to estimate the extreme low water elevation. Staff Exh. 1 (SER) at 2-120. The NRC Staff determined the minimum water surface elevation to be 242.9 ft msl. Staff Exh. 2

(SER Supp.) at 2-6. Because Dominion proposed minimum water surface elevation site characteristic (242 ft msl) is lower than the NRC Staff's estimate, the NRC Staff determined that Dominion's value is acceptable. Staff Exh. 1 (SER) at 2-121. See Staff Exh.6 at 35 (response to safety question 46). The NRC Staff concluded that Dominion had met the requirements related to low water considerations. Staff Exh. 1 (SER) at 2-122.

(F) Groundwater

60. The evaluation of groundwater has a number of objectives. These include: (1) determining the maximum site groundwater elevation that could be used as a design basis for hydrostatic loading on subsurface structures; (2) evaluating the availability of groundwater as a source of plant water supply;[20] (3) evaluating impacts of groundwater withdrawal on offsite users; and (4) considering the potential impact of accidental liquid releases to groundwater. Tr. 251-52 (Matthews); Staff Exh. 14 (RS-002) at 2.4.12-2 to 2.4.12-3.

61. To determine the maximum site groundwater elevation, Dominion used a network of 19 observation wells at the ESP Site to investigate groundwater levels, as well as to provide other required groundwater characteristics. Because the existing units' groundwater monitoring wells were not considered to be of sufficient areal extent to determine groundwater levels beneath the ESP Site, nine additional observation wells were installed as part of the ESP subsurface investigation program. Water levels in these nine wells and ten of the existing units' monitoring wells were measured quarterly for one year, followed by a supplementary measurement in February 2005, to provide data on seasonal groundwater level fluctuations at the site, as well as groundwater gradient and flow direction. Dom. Exh. 9 (Dom. Safety Test.) at 19; Tr. 253-54 (Matthews).

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[20] If groundwater is to be used as an essential source of water for safety-related equipment, the design basis for protection against natural and accident phenomena should be considered. Staff Exh. 14 (RS-002) at 2.4.12-2.

62. Like the existing units, new units would be built at Elevation 271 feet msl or higher. Previous studies conducted for the NAPS site predicted that the maximum groundwater elevations beneath the site in the plant area could reach as high as Elevation 265 to 270 feet. Based on evaluations of groundwater levels and fluctuations at the site, the effects of topography and site grading, and the presence of Lake Anna, Dominion similarly estimated that the design groundwater level in the plant area of the ESP Site would range from Elevation 265 to 270 feet msl. Dom Exh. 9 (Dom. Safety Test.) at 19-20; Dom. Exh. 11, SSAR § 2.4.12.4; Tr. 254 (Matthews).

63. With regard to potential use of groundwater as a source of water supply, Dominion determined early in its investigation that the aquifer beneath the North Anna site is not a viable source of water for safety-related purposes due to its low yield. Tr. 252 (Matthews). Therefore, groundwater will not be used for any safety-related function. Dom. Exh. 11, SSAR at 2-1-65.

64. With respect to the potential impact on offsite groundwater users, Lake Anna to the north, the lake and discharge canal to the east, and tributaries to the lake on the south and the west form hydrologic boundaries to groundwater movement. In addition, there is a groundwater divide to the south of the ESP Site, which results in groundwater generally flowing to the north in that area. Tr. 255-56 (Matthews). Groundwater flow beneath the ESP Site is generally northward and eastward, toward Lake Anna. Id.; Dom. Exh. 9 (Dom. Safety Test.) at 26; Dom. Exh. 11, SSAR § 2.4.12.1.2.

65. There are no known users of large quantities of groundwater within 25 miles of the ESP Site. Public water supply wells closest to the existing units are about 2.6 miles to the northwest and about 4.3 miles to the south-southeast. The residential water supply well nearest the site is about one mile to the south-southeast. Based on their distance from the site and the presence of

one or more arms of Lake Anna between the site and these wells, the new units are not expected to affect these wells Dom. Exh. 9 (Dom. Safety Test.) at 20; Tr. 256-57 (Matthews); Dom. Exh. 11, SSAR § 2.4.12.2; Staff Exh. 1 (SER) at 2-126; For this reason, the Staff did not need to evaluate the groundwater pathway. Tr. 635 (Stoetzel).

66. With respect to the potential impact of accidental releases, Dominion determined groundwater flow velocity and direction based on on-site measurements of pertinent parameters. More specifically, Dominion measured the hydraulic gradient, hydraulic conductivity, and soil porosity. Tr. 257 (Matthews); Tr. 285-86 (Taylor); Tr. 430-31 (Smith); Dom. Exh. 11, SSAR at 2-2-142. See also Tr. 219 (Bagchi). These three parameters were used to determine a groundwater velocity of 0.31 feet per day flowing from the site toward the lake. The NRC, in its SER, determined that this would result in a 16-year travel time from the ESP area to Lake Anna. Tr. 257 (Matthews); Staff Exh. 1 (SER) at 2-127. In addition, conservative values of distribution coefficients ("K_d") were obtained by relating on-site measurements of soil characteristics to K_d values published in the literature. Dom Exh. 9 (Dom. Safety Test.) at 20; Dom. Exh. 11, SSAR § 2.4.13 and Table 2.4-20; Staff Exh. 1 (SER) at 2-134.

67. In its SER, the NRC Staff concluded that Dominion had provided sufficient information pertaining to liquid pathways (Staff Exh. 1 (SER) at 2-136), but also determined that uncertainty exists in the characterization of subsurface radionuclide migration (id.). This uncertainty is the result of lack of specific design information allowing identification of the specific radionuclides in a release; lack of specific design information on the final location of the release point; and uncertainty in adsorption and retention coefficients, which may be unique to each radionuclide and could be affected by chemical properties of the soil. Id. at 2-135 to 2-136.

68. The NRC Staff resolved this issue by imposing ESP Permit Condition 4, which will require that the radioactive waste management systems, as defined in Regulatory Guide 1.143, for a future reactor include features to preclude accidental releases of radionuclides into potential liquid ground water pathway.[21] Id. at 21; Staff Exh. 1 (SER) at 2-136. Dominion intends to comply with this permit condition in preparing any COL application based on the ESP. Dom. Exh. 9 (Dom. Safety Test.) at 21. Safeguards would be used to minimize the potential for adverse impacts to the groundwater by construction and operation of the new units. Id.; Tr. at 639, 641 (Bagchi). These safeguards may include the use of lined containment structures around storage tanks and hazardous materials storage areas, emergency cleanup procedures to capture and remove surface contaminants, or other measures deemed necessary to prevent or minimize adverse impacts to the groundwater beneath the ESP Site. Dom. Exh. 9 (Dom. Safety Test.) at 21.

69. The Board explored why it was not possible to perform a bounding analysis. The testimony of the NRC Staff and Dominion convince the Board that this is not practical. The NRC Staff testified that on-site measurements of adsorption and retention coefficients, which would require considerable expense, are going to change because of construction activities. Pathways are going to be substantially altered, and coefficients are going to be changed by backfill. Tr. 224 (Bagchi). An excavation to accommodate the powerblock is going to be substantially more than the nominal dimensions and would substantially cut into the liquid pathway. Thus, there are substantial impediments to measuring these coefficients at this time. Tr. 226 (Bagchi).

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[21] Permit Condition 4 is revised from the wording in the SER to conform to the wording approved by the Commission for the ESP issued in the Clinton and Grand Gulf proceedings. Tr. 611-12 (Bagchi).

70. Dominion testified that, in the context of plants enveloped by the PPE, there is no specific information with respect to locations of potential spills, the distances from the lake, and depths of the various foundations. Tr. 258 (Matthews). Further the distribution coefficients are element specific, and the difficulty at the ESP stage is in knowing what source of liquid could be accidentally released. The contents, the isotopes present, and their concentrations in a potential liquid release are widely variable from design to design. The volume of tank considered in a rupture scenario is also important and specific to a particular design. Therefore, it becomes very difficult to know for which elements the K_d values should be measured. Tr. 286 (Taylor). Dominion's witness Dr. Taylor, who has been involved in such analyses, doubted that a bounding analysis could be defended. Tr. 289 (Taylor).

71. The Board also inquired whether this approach complies with 10 C.F.R. § 100.20(c)(3), which states that factors important to hydrological radionuclide transport (such as soil, sediment and rock characteristics, adsorption and retention coefficients, groundwater velocity, and distances to the nearest surface body of water) must be obtained from on-site measurements. Upon consideration of the case law and testimony, the Board is now convinced that the NRC Staff's approach is permissible, for a number of reasons.

72. First, Dominion did establish parameters important to radionuclide migration by site specific measurements. As discussed above, these parameters included hydraulic gradient, hydraulic conductivity, and porosity, establishing site specific values of groundwater flow direction and velocity. Tr. 257 (Matthews); Tr. 285-86 (Taylor); Tr. 430-31 (Smith); Dom. Exh. 11, SSAR at 2-2-142. See also Tr. 219 (Bagchi). These parameters establish a 16-year travel time from the ESP Site to the lake. This is ample time to interdict or remediate a spill; and Dominion has committed as part of its Groundwater Protection Initiative to install monitoring wells down-gradient

of the new units, thus the capability to detect and react to a groundwater contamination event. Tr. 272-73 (Tarantino), 274 (Hintz), 422 (Tarantino, Smith), 423-24 (Smith); see also Dom. Exh. 12 at 17. Therefore, the Board sees no site suitability issue.

73. Second, the only parameter that was not determined by a site specific measurement was the adsorption and retention coefficients. Tr. 430 (Smith). But the 16-year estimated groundwater travel time does not take credit for any adsorption or retention of radionuclides, which would only delay their migration to the Lake. Thus, the analysis is effectively assuming a bounding value of no sorption. Tr. 246 (Vail); Tr. 430-31 (Smith).

74. The Board believes that this is permissible under 10 C.F.R. § 100.20(c)(3). 10 C.F.R. § 100.20 identifies "factors to be considered" as opposed to the "criteria" in sections 100.21 and 100.23 that a proposed site must meet. 10 C.F.R. § 100.20 states that "[t]he Commission will take the following factors into consideration in determining the acceptability of a site for a stationary power reactor." Thus, there is considerable latitude under this regulation to determine how such factors are taken into consideration. Further, Section 100.20(c)(3) calls for consideration of factors "important to" radionuclide transport – again providing latitude in determining what factors are important. It is reasonable to construe the reference to factors "such as" adsorption and retention coefficients as only examples of characteristics that might be important, and not as a definitive list of characteristics that must be measured in every case. Here, where no credit is being given to adsorption and retention, measuring such values is not "important." Measured adsorption and retention coefficients are also not important if groundwater releases are precluded, as ESP Condition 4 specifies.

75. Third, the Board views the Commission's decisions in the Grand Gulf and Clinton ESP proceedings[22] as approving ESP Condition 4 as an acceptable means of complying with 10 C.F.R. § 100.23(c)(3). As the NRC Staff pointed out in oral argument, the issue of compliance with 10 C.F.R. § 100.20(c)(3) was clearly before the Commission, as evidenced by the Staff's briefs in those proceedings.[23] Tr. 779-80.

76. Finally, we note the NRC Staff's testimony that an analysis of a radioactive spill will be performed in any COL proceeding. As the NRC Staff testified,

> [A]s part of the SRP in Chapter 11.2, there's a requirement there as part of the COL application package that one of the scenarios that's considered is the rupture of the tank containing radioactive liquid waste. So what the COL applicant is supposed to do as part of the application package: examine the type of radioactive waste, liquid waste and wet waste that will be generated. From those different type of waste streams, identify one of the waste streams that has, perhaps, the higher contamination level; put this into a tank that will be used for storage; and then assume that 80 percent of the tank fails, the tank fails, 80 percent of content is released; and assess the radiological impact to the nearest groundwater well or nearest water surface body which may be used for drinking purposes. That's the requirement in Chapter 11.2 of the SRP. So the COL applicant has to address this at the COL stage.

Tr. 248 (Dehmel). Therefore, we are confident that these issues will be examined again at the COL stage, when they are ripe for review.

(iii) Seismology and Geology

(A) General Description of Site Area and Regional Geology

77. Pursuant to 10 C.F.R. § 100.23(c), the geological and seismological characteristics of a site and its environs must be investigated in sufficient scope and detail to allow for both an adequate

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[22] Exelon Generation Company, LLC (Early Site Permit for Clinton ESP Site), CLI-07-12, 65 N.R.C. __, slip op. (Mar. 8, 2007); System Energy Resources, Inc. (Early Site Permit for Grand Gulf ESP Site), CLI-07-14, 65 N.R.C. __, slip op. (Mar. 27, 2007).

[23] Exelon Generation Company, LLC (Early Site Permit for Clinton ESP Site), Docket No. 52-007-ESP, NRC Staff's Response to Commission's January 22, 2007 Order (Feb 1, 2007) (ML070330555); System Energy Resources, Inc. (Early Site Permit for Grand Gulf ESP Site), Docket No. 52-009-ESP, NRC Staff Brief in Response to CLI-07-07 (Feb. 26, 2007) (ML070590740).

evaluation of the proposed site and adequate engineering solutions to actual or potential geologic and seismic effects at the proposed site. Dom. Exh. 9 (Dom. Safety Test.) at 21.

78. Dominion developed regional and site area geological and seismological information in accordance with the guidance in Section 2.5.1 of RG 1.70, "Standard Format and Content of Safety Analysis Reports for Nuclear Power Plants – LWR Edition," November 1978, and RG 1.165, "Identification and Characterization of Seismic Sources and Determination of Safe Shutdown Earthquake Ground Motion," March 1997. Dom. Exh. 9 (Dom. Safety Test.) at 21; Tr. 694 (Lettis).

79. Dominion used multiple sources of data to develop the regional and site area geological and seismological information, including:

- Reviews of previous reports prepared for the existing NAPS Units 1 and 2, and abandoned Units 3 and 4, including site-specific reports reviewed included the NAPS UFSAR and the NAPS Independent Spent Fuel Storage Installation ("ISFSI") Safety Analysis Report (SSAR Section 2.5.1);
- Reviews of published and unpublished geologic maps and literature;
- Interpretation of aerial photography;
- Conducting a subsurface investigation;
- Contacting local researchers who were performing geologic and seismologic work in the site region; and
- Conducting geologic field and aerial reconnaissance.

Dom. Exh. 9 (Dom. Safety Test.) at 22-23; Tr. 694-96 (Lettis).

80. Dominion followed the guidance in Appendix D to RG 1.165 in conducting its investigation of the regional and site geological and seismological information. Dom. Exh. 9 (Dom. Safety Test.) at 21; Tr. 694 (Lettis). Dominion used a "site region," defined as the area within 200 miles of the ESP Site, and a "site area," defined as the area within 5 miles of the ESP

Site. Dom. Exh. 9 (Dom. Safety Test.) at 22; see Tr. 695 (Lettis). Dominion investigated and characterized the physiography, geologic history, stratigraphy, and tectonic setting of the site region. Dom. Exh. 9 (Dom. Safety Test.) at 22; Tr. 696 (Lettis).

81. Dominion examined the principal tectonic structures within the site region based on their age of formation or reactivation. Dom. Exh. 11, SSAR § 2.5.1.1; Dom. Exh. 9 (Dom. Safety Test.) at 22. The geologic units in the site area and the faults date from approximately 200 million to 600 million years ago. Tr. 698 (Lettis). The site area was investigated to determine if any previously unmapped faults exist, and no previously unmapped faults were found. Id.

82. A fault, called "fault a." traverses the North Anna site. Tr. 698 (Lettis). A thorough investigation of this fault in 1973 provided conclusive evidence that "fault a" has not been active in the last 200 million years. Tr. 699 (Lettis). Dominion was able to confirm that there were no extensions of the fault by field reconnaissance that included examining road cuts that were made across where "fault a" was supposed to extend. The road cuts that Dominion examined extended down through the soil and into the bedrock below, and if a fault is there, whether it has been active or not, it will still be there. In the road cuts that Dominion examined that cut across the postulated length of fault "a," there were no faults in the bedrock. Tr. 701-03, 706-08 (Lettis). The investigation of "fault a" thus found no evidence to support an extension of the fault from its initial mapped length. Tr. 699-712 (Lettis). Dominion also confirmed that there is no evidence of fault activity. Tr. 700, 710-11 (Lettis).

83. From these geological and seismological investigations, it was determined that none of the principal tectonic structures reviewed are considered to be capable tectonic sources as defined in Appendix A to RG 1.1.65. Dom. Exh. 9 (Dom. Safety Test.) at 22; Dom. Exh. 11, SSAR § 2.5.1.1.4.

84. The geological and seismological investigations found no physical evidence of any fissuring, liquefaction, landsliding, lurching, or caving of banks to indicate that past earthquake ground shaking has disturbed either the surficial sediments or bedrock beneath the ESP Site. Dom. Exh. 11, SSAR §§ 2.5.1.2.5 and 2.5.1.2.6.d; Dom. Exh. 9 (Dom. Safety Test.) at 22; Tr. 711 (Lettis).

85. Dominion determined that there is no potential for tectonic surface faulting or other forms of non-tectonic permanent ground deformation at the ESP Site. Dom. Exh. 9 (Dom. Safety Test.) at 22; Tr. 710-11 (Lettis).

(B) Vibratory Ground Motion

86. 10 C.F.R. 100.23(c) requires that an ESP applicant investigate the geologic, seismologic, and engineering characteristics of the proposed site and its environs with sufficient scope and detail to support estimates of the Safe Shutdown Earthquake Ground Motion ("SSE"), which is calculated to permit adequate engineering solutions to actual or potential geologic and seismic effects at the proposed site. The application of Appendix S to 10 C.F.R. Part 50 in an ESP review, as referenced in 10 C.F.R. § 100.23(d)(1), is limited to defining the minimum SSE for design. Staff Exh. 1 (SER) § 2.5.2.2.

87. Dominion used two different approaches in developing the SSE for the design of a nuclear power plant for the ESP Site: a performance-based approach and a reference-probability approach. Dom. Exh. 11, SSAR at 2-2-247, 2-2-273; Tr. 726-27 (McGuire).

88. The performance-based approach uses a methodology adopted from three recent studies that recommend seismic design levels for nuclear facilities in the United States: DOE 1020 (USDOE, "Natural phenomena hazards design and evaluation criteria for Department of Energy facilities," U.S. Department of Energy, Washington, D.C., Rept. DOE-STD-1020-2002, January

2002), a draft ASCE standard (American Society of Civil Engineers, "Seismic design criteria for structures, systems, and components in nuclear facilities and commentary," ASCE draft standard, July 25, 2003), and Risk Engineering, Inc., "Technical basis for revision of regulatory guidance on design ground motions: hazard- and risk-consistent ground motion spectra guidelines," USNRC, Report NUREG/CR-6728, October 2001. Dom. Exh. 11, SSAR at 2-2-247.

89. The performance-based approach develops a "performance-based-spectrum" that has, as its goal, achieving a mean annual frequency of 10^{-5} of unacceptable performance of nuclear structures, systems, and components as a result of seismically initiated events. Dom. Exh. 11, SSAR § 2.5.2.6.7(b); Tr. 734 (Lettis). For the performance-based approach, Dominion selected the ground motion level for the SSE spectrum to ensure that the annual probability of seismic effects on the plant, measured in terms of seismically induced core damage, is as low as calculated at other nuclear plants in the U. S. designed to current standards. Dom. Exh. 11, SSAR § 2.5.2.6.7(b).

90. The 10^{-5} mean probability of failure of any specific plant component used in the performance-based approach results in a mean seismic core damage frequency lower than 10^{-5} – around 0.5 to 0.2 x 10^{-5}. Tr. 734-35. Because Dominion's SSE envelopes both the performance-based spectrum and the reference-probability-based spectrum, it guarantees that the plant will have a seismic core damage frequency in the 0.5 x 10^{-5} to 0.2 x 10^{-5} range. Tr. 734-35 (McGuire).

91. A plant designed to the performance-based SSE calculated by Dominion for the ESP Site would have a more conservative seismic design basis than the majority of 25 currently licensed nuclear power plants for which seismic probabilistic risk assessments have been conducted. Dom. Exh. 11, SSAR § 2.5.2.6.7(b); Tr. 735-36 (McGuire).

92. Dominion also developed an SSE using the reference probability approach set forth in RG 1.165. Dom. Exh. 11, SSAR § 2.5.2.6.7(a); Dom. Exh. 9 (Dom. Safety Test.) at 23; Tr. 724 (McGuire). RG 1.165, Appendix B outlines a means of calculating a SSE for the seismic design of a nuclear power plant by establishing a reference probability for the SSE ground motion that is equivalent to the safest 50 percent of existing nuclear plants. Dom. Exh. 11, SSAR § 2.5.2.6.7(a). As defined in Regulatory Guide 1.165, the "reference probability" is the annual probability level such that 50% of a set of currently operating plants (selected by the NRC in Table B.1 of RG 1.165) has an annual median probability of exceeding the SSE that is below this level. Dom. Exh. 1 at 16 (response to safety question 62). This approach ensures that the seismic design of a new plant would be equivalent, in terms of annual probability of exceedance of the seismic design level, to existing plants. Dom. Exh. 11, SSAR § 2.5.2.6.7(a); Dom. Exh. 16 at 10.

93. Inherent in this reference probability approach is the basic premise that the level of seismic hazard applicable to existing units is acceptable for both existing and new units. The basis for the procedure in RG 1.165, as well as the determination of the reference probability, is that existing nuclear power plants do not represent an undue risk to the health and safety of the public. Staff Exh. 1 (SER) at 2-177; Tr. 656-57 (Munson). Indeed, in issuing the final rule adopting probabilistic seismic hazard analysis as the method of establishing the SSE, the Commission stated "the basic premise in establishing the target exceedance probability is that the current design levels are adequate." 61 Fed. Reg. 65,157, 65,164 (Dec. 11, 1996). Therefore, the benchmark for new plants is not a specific numerical exceedance value, but the level of exceedance corresponding to the set of reference plants.

94. When Regulatory Guide 1.165 was published in 1997, the reference probability calculated at the time, based on the data collected up through 1984,[24] was 1 x 10^{-5} based on the median probability. Staff Exh. 1 (SER) at 2-199 to 2-200. However, RG 1.165, Appendix B provides a methodology for calculating a new reference probability on which design basis ground motions should be calculated. Dom. Exh. 11, SSAR § 2.5.2.6.7(a); Tr. 656-57 (Munson); Tr. 724 (McGuire); Tr. 746-48 (Lettis). Regulatory Guide 1.165 states:

> Appendix B discusses situations in which an alternative reference probability may be more appropriate. The alternative reference probability is reviewed and accepted on a case by case basis. Appendix B also describes a procedure that should be used when a general revision to the reference probability is needed.

RG 1.165 at 7. Appendix B to RG 1.165 provides the procedure that should be used if general revisions to the Probabilistic Seismic Hazard Analysis ("PSHA") methods or data bases result in significant changes in hazard predictions for selected plant sites. RG 1.165 at 12. Appendix B also notes that a higher reference probability may be more appropriate and acceptable for some sites, "considering the slope characteristics of the site hazard curves, the overall uncertainty in calculations (i.e., differences between mean and median hazard estimates), and the knowledge of seismic sources that contribute to hazard." Id. It notes that use of a higher reference probability will be reviewed and accepted on a case-by-case basis. Id. n.1.

95. The NRC Staff explained in its responses to the Board's questions:

> The Staff has recognized that the reference probability approach would require updating the reference probability value as new advances are made in the earth sciences. As mentioned above, the reference probability is computed from the median probabilities of exceeding the SSEs at 29 sites in the CEUS. The selected

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[24] The reference probability calculated in RG 1.165, Appendix B is based on seismic hazard results from the "Revised Livermore Seismic Hazard Estimates for Sixty-Nine Nuclear Power Plant Sites East of the Rocky Mountains," (NUREG-1488 (April 1994)), and Electric Power Research Institute (Rept. NP-6395-D, Probabilistic seismic hazard evaluations at nuclear plant sites in the central and eastern United States: resolution of the Charleston earthquake issue. EPRI, April 1989) – studies that cataloged seismic sources in the Central and Eastern United States up through 1984. Staff Exh. 1 (SER) at 2-177-78; Dom. Exh. 11, SSAR § 2.5.2.6.7(a); Dom. Exh. 9 (Dom. Safety Test.) at 23; Tr. 653 (Munson), 710-11 (Lettis).

> sites were intended to represent relatively recent designs, which used conservative seismic designs, in order to ensure an adequate level of conservatism in determining the SSE for future sites. However, as the reference probability is based on the probability of exceeding the SSEs at all 29 sites, new models of seismic activity or ground motion in the vicinity of a few sites would necessitate updating the seismic hazard estimates for all of the sites in order to determine a new reference probability. In other words, each prospective siting application would need to potentially justify a current reference probability value, which would require it to update the seismic hazard estimates for all of the 29 CEUS sites.

Staff Exh. 6 at 48 (response to safety question 59).

96. Consistent with RG 1.165, Position 2 and Appendix E, Dominion updated EPRI's 1989 PSHA to include more recent seismicity, more recently proposed seismic sources, and more recently developed ground motion attenuation models. Dom. Exh. 9 (Dom. Safety Test.) at 23. Dominion updated the seismicity catalog by including data from 1985 through 2001. Tr. 712-13 (Lettis). Dominion evaluated potential seismic sources, conducting sensitivity analyses with regard to the East Coast Fault system and the Charleston earthquake and updated seismic source parameters, such as the Charleston earthquake to reflect potential effects at the ESP Site. Tr. 713-19 (Lettis). Dominion calculated a new PSHA incorporating 2003 EPRI ground motion models and updated seismic hazard results for the ESP Site. Dom. Exh. 9 (Dom. Safety Test.) at 23.

97. The revised 2003 EPRI ground motion models and the new seismic source parameters identified by Dominion demonstrate that the median reference probability published in RG 1.165 with regard to the 29 nuclear plants does not accurately reflect the probability of exceedance of the seismic design of the SSEs of those 29 plants, but underestimates the median probability of exceedance of those SSEs. See Staff Exh. 1 (SER) at 2-178; Dom. Exh. 11, SSAR § 2.5.2.6.7(a). Therefore, consistent with RG 1.165, Dominion used a 5×10^{-5} mean probability of exceedance of the SSE as the design basis for any reactor built at the ESP Site to update the reference

probability to account for updated knowledge regarding earthquakes and ground motions. Dom. Exh. 11, SSAR § 2.5.2.6.7(a); Dom. Exh. 9 (Dom. Safety Test.) at 23; Tr. 724-25 (McGuire), 746-47 (Lettis).

98. The NRC Staff independently determined a mean $5x10^{-5}$ reference probability to be conservative by comparison to the SSE design levels at 29 existing nuclear plant sites in the central and eastern United States. Staff Exh. 1 (SER) at 2-193, 2-199 to 2-200; Tr. 725-26 (McGuire).[25] The NRC Staff is satisfied that the procedure used by Dominion to determine the SSE is sufficiently conservative, and that the controlling earthquakes and ground motions from those controlling earthquakes used to determine the SSE adequately reflect the local and regional hazard for the ESP Site. Tr. 673-74 (Munson).

99. An SSE calculated for the ESP Site based on a 5×10^{-5} mean probability of exceedance is appropriately conservative as the design basis for any reactor built at the ESP Site because:

- The mean reference probability calculated on the basis of the data used to calculate the 1×10^{-5} median reference probability is equivalent to a 1×10^{-4} mean reference probability, which is a higher probability of exceedance than mean 5×10^{-5} (Tr. 673-74 (Munson));
- An SSE calculated using a 1×10^{-5} median reference probability does not accurately reflect the seismic design bases of the 29 existing nuclear power plants because new data would increase that median reference probability (see Tr. 674-75 (Munson), Tr. 725 (McGuire)), and those nuclear power plants do not represent an undue risk to the health and safety of the public (Staff Exh. 1 (SER) at 2-177; Tr. 656-57 (Munson));
- The SSE calculated using a median reference probability $1x10^{-5}$ rather than a mean reference probability of $5x10^{-5}$ results in an SSE that would have higher high frequency ground motions, which are not damaging to nuclear power plant structures (Tr. 682-86, 690 (Munson));

[25] Reference probabilities based on a median versus mean calculation cannot be compared to one another. Tr. 726-28 (McGuire). The 1×10^{-5} median reference probability published in RG 1.165 is equivalent to a 1×10^{-4} mean reference probability. Tr. 673 (Munson); Staff Exh. 6 at 49 (response to safety question 60).

- The actual performance of any plant constructed at the ESP Site, in terms of seismic core damage frequency, would be lower than 1 x 10^{-5} mean frequency of exceedance with an actual mean frequency around 0.5 x 10^{-5} to 0.2 x 10^{-5}. Tr. 734-35 (McGuire);

- The actual performance of any plant constructed at the ESP Site, in terms of seismic core damage frequency, would be better than the majority of 25 existing nuclear power plants for which seismic probabilistic risk assessments have been conducted (Dom. Exh. 11, SSAR § 2.5.2.6.7(b); Tr. 735-36 (McGuire)); and

- The mean hazard curves are higher then the median curves (Dom. Exh. 16 at 12); Tr. 658-59 (Munson), 728 (McGuire). Because the mean hazard curves are higher than the median curves, Dominion's use of the mean curves is conservative. Staff Exh. 1 (SER) at 2-199.

100. Applying the reference probability to the updated seismic hazards results, Dominion identified two controlling earthquakes (magnitude 5.4 at 20 km that would generate high frequencies and a "low frequency" earthquake of magnitude 7.2 at 308 km). Staff Exh. 1 (SER) at 2-200; Dom. Exh. 11, SSAR § 2.5.2.6.7(c); Dom. Exh. 9 (Dom. Safety Test.) at 23; Tr. 732-33 (McGuire). Dominion then determined the ground motion response spectra for the two controlling earthquakes. Dom. Exh. 9 (Dom. Safety Test.) at 23; Tr. 733 (McGuire).

101. As described in Appendix F to RG 1.165, any smooth spectral shape that envelops the two controlling earthquake response spectra is acceptable as the site SSE. Staff Exh. 1 (SER) at 2-200. The spectrum calculated by Dominion enveloped the two controlling earthquakes by conservatively enveloping the higher of the two earthquake spectra at any frequency. Staff Exh. 1 (SER) at 2-200; Tr. 732-33 (McGuire); Dom. Exh. 16 at 17. Dominion's SSE also envelopes both the performance-based spectrum and the reference-probability-based spectrum (Tr. 735, 737-78 (McGuire)), and is conservative as a design basis for any nuclear power plant built at the ESP Site. Tr. 674 (Munson); Tr. 736, 744-45 (McGuire).

102. Dominion's SSE spectrum is also conservative due to changes in the techniques for calculating seismic hazard that have occurred since the calculations were made regarding the

SSE in 2003. These changes would reduce the hazard curve for the ESP Site and include: (1) cumulative absolute velocity evaluation, which recognizes that very small magnitude earthquakes have less capability of damaging engineered structures, and (2) a new set of standard deviations for the ground motion equations that would reduce the hazard from those 2003 EPRI ground motion equations. Tr. 744-45 (McGuire).

103. To determine the vertical SSE spectrum, Dominion used appropriate V/H response spectral ratios provided in NUREG/CR-6728 and confirmed the appropriateness of these V/H ratios by performing a site-specific analysis that indicated that the ratios were conservative because the ESP Site-specific ratios are approximately 30% lower than the V/H ratios provided in NUREG/CR-6728 for a peak ground acceleration between 0.2g and 0.5g. See Staff Exh. 1 (SER) at 2-200; Dom. Exh. 11, SSAR § 2.5.2.6.7(d). The NRC Staff independently confirmed the adequacy of the V/H SSE ratios. Staff Exh. 1 (SER) at 2-200 to 2-201.

104. The Operating Basis Earthquake Ground Motion ("OBE") spectrum was selected as one-third of the SSE spectrum, as permitted by 10 C.F.R. Part 50, Appendix S. Dom. Exh. 11, SSAR § 2.5.2.7; Tr. 733 (McGuire).

(C) Surface Faulting

105. As required by 10 C.F.R. § 100.23, Dominion performed investigations of the site area geology (conducted in accordance with the guidance provided in RG 1.165) to assess the potential for surface fault rupture at and within a 5-mile radius of the ESP Site – including: (1) reviewing previous reports prepared for the existing NAPS Units 1 and 2, and abandoned Units 3 and 4; (2) reviewing published and unpublished geologic maps and literature; (3) interpreting aerial photography; (4) conducting a subsurface investigation; (5) contacting local researchers performing geologic and seismologic work in the site region; and (6) conducting geologic field

and aerial reconnaissance (Tr. 694-96 (Lettis)) – to determine the potential for tectonic surface and nontectonic deformations at the ESP Site. Dom. Exh. 11, SSAR § 2.5.3.1; Dom. Exh. 9 (Dom. Safety Test.) at 24. Based on the results of these investigations, it was determined that there are no geologic faults or other tectonic structures that pose a surface faulting hazard at the site. Dom. Exh. 11, SSAR § 2.5.3; Dom. Exh. 9 (Dom. Safety Test.) at 24; Tr. 710-11 (Lettis). Therefore, at the ESP Site, the potential for tectonic deformation was determined to be negligible and no evidence was found of non-tectonic deformation, such as glacially induced faulting, collapse structures, growth faults, salt migration, deep-seated landslides, or volcanic intrusion. Dom. Exh. 9 (Dom. Safety Test.) at 24; Tr. 711 (Lettis). The NRC Staff, with the assistance of the United States Geological Service, visited the ESP Site and independently interpreted data analyzed by Dominion. Staff Exh. 1 (SER) at 2-207.

(D) Stability of Subsurface Materials and Foundations

106. To comply with the requirements of 10 C.F.R. § 100.23(c), Dominion investigated the stability of subsurface materials and foundations at the ESP Site to demonstrate the safety of Seismic Category I facilities planned to be constructed. Dom. Exh. 9 (Dom. Safety Test.) at 24.

107. During November and December 2002, Dominion performed a subsurface investigation program at the ESP Site, consistent with the guidance in RS-002, Section 2.5.4, covering the area enveloped for the new units as well as cooling towers for the new units. Dom. Exh. 9 (Dom. Safety Test.) at 24. The ESP Site exploration program was performed using selected guidance provided in Revision 1 of RG 1.132, "Site Investigations for Foundations of Nuclear Power Plants," March 1979, and Proposed Revision 2 of RG 1.132 (DG-1101), issued in February 2001. Dom. Exh. 11, SSAR § 2.5.4.3.2; Dom. Exh. 9 (Dom. Safety Test.) at 24-25.

108. Dominion conducted numerous laboratory tests of soil and rock samples consistent with the guidelines provided in RG 1.138, "Laboratory Investigation of Soils for Engineering Analysis and Design of Nuclear Power Plants," April 1978, and proposed Revision 1 of RG 1.138 (DG-1109), issued in August 2001. Dom. Exh. 11, SSAR § 2.5.4.2.4; Dom. Exh. 9 (Dom. Safety Test.) at 25.

109. Dominion performed geologic and geotechnical investigations (including geophysical and laboratory testing and analyses) on soil and rock samples, in order to determine their index properties, shear strength (soil), compression strength (rock), consolidation and compressibility, dynamic properties, and resistance to seismic effects. Dom. Exh. 9 (Dom. Safety Test.) at 25. The results of the investigations by Dominion are consistent with the results from previous site investigations for existing NAPS Units 1 and 2, and abandoned NAPS Units 3 and 4, and are an adequate basis for the design of safety-related plant structures at the ESP Site. Dom. Exh. 9 (Dom. Safety Test.) at 25.

110. Dominion's investigations determined that the sound bedrock at the site has adequate bearing capacity for maximum bearing pressures from any of the reactor designs being considered in this ESP. Dom. Exh. 9 (Dom. Safety Test.) at 25; Dom. Exh. 11, SSAR § 2.5.4.

111. Dominion conducted soil liquefaction analyses based on guidance in draft RG DG-1105, "Procedures and Criteria for Assessing Seismic Soil Liquefaction at Nuclear Power Plant Sites," March 2001. Dom. Exh. 9 (Dom. Safety Test.) at 25. Based on these analyses, Dominion concluded that portions of the saprolitic soils at the ESP Site, classified as Zone IIA saprolites, have the potential for earthquake-induced instability resulting from liquefaction. Dom. Exh. 9 (Dom. Safety Test.) at 25. These soils, however, would not have an effect on most safety-related

structures at the ESP Site, including the reactor containment building, which would be founded on sound bedrock. Dom. Exh. 9 (Dom. Safety Test.) at 25.

112. If any safety-related supporting structures (*e.g.*, diesel generator, pump structures, tanks, etc.) are founded on the Zone IIA saprolitic soil, Dominion will use appropriate soil improvement techniques, including removal and replacement of soils, to reduce potential settlements to acceptable tolerances and eliminate any liquefaction potential. Dom. Exh. 11, SSAR§ 2.5.4.8; Dom. Exh. 9 (Dom. Safety Test.) at 25-26.

(E) Stability of Slopes

113. To comply with 10 C.F.R. § 100.23, Dominion evaluated the stability of all earth and rock slopes, both natural and planned man-made, consistent with the guidance provided in RS-002, Section 2.5.5, to determine the acceptability of the ESP Site. Dom. Exh. 9 (Dom. Safety Test.) at 26. Dominion conducted a slope stability analysis of the only existing slope at the ESP Site whose failure could adversely affect the safety of the new units. Id.

114. The slope is a 55-foot high, 2-horizontal to 1-vertical (2h:1v) slope, made almost entirely out of cut material, that descends from the north of the NAPS Units 1 and 2 service water reservoir ("SWR") down to the south of the existing excavation made for the abandoned NAPS Units 3 and 4. Id. Because the top of the slope is 200 feet from the top of the SWR embankment, any potential instability of the slope would have no impact on the stability of the SWR embankment. Dom. Exh. 9 (Dom. Safety Test.) at 26. Sloughing or collapse of the slope could impact the new units, depending on their final location. Id.

115. The slope stability analysis indicated that the existing slope was stable under long-term static conditions; however, some liquefaction in the slope area may be possible. Id. Measures will be taken to ensure the safety of the slope and the structures that may be located close to the

bottom of the slope as part of detailed engineering for any new units at the ESP Site. Dom. Exh. 11, SSAR § 2.5.5.6; Dom. Exh. 9 (Dom. Safety Test.) at 26.

116. If the selected design for new units requires that a new slope be constructed, and it is deemed that any failure of the new slope could impact the new units, then an investigation and analysis of the new slope would be performed as part of detailed engineering and described in the COL application. Dom. Exh. 9 (Dom. Safety Test.) at 26-27. If the analysis, based on the subsurface investigation results, showed an inadequate factor of safety against slope failure, then the design would be modified to eliminate any risk of slope failure. Dom. Exh. 11, SSAR § 2.5.5.5; Dom. Exh. 9 (Dom. Safety Test.) at 27.

e. Emergency Planning

117. As previously stated, 10 C.F.R. § 100.20(a) also requires identification of physical characteristics unique to the proposed site that could pose a significant impediment to the development of emergency plans. This is also a criterion in 10 C.F.R. § 100.21(g), and § 52.17(b)(1).

118. NAPS is an existing nuclear station with existing emergency plans that have been determined to be adequate by FEMA, and are subject to regular drills and exercises. Dom. Exh. 9 (Dom. Safety Test.) at 27. As discussed in Section 13.3.2.1 of the SSAR, evacuation time estimates have been calculated taking into consideration the characteristics of the site, including the characteristics of the roads, seasonal recreational visitors around the lake, and school populations. Id.; Dom. Exh. 11, SSAR at 2-13-2. These evacuation time estimates demonstrate that there are no unique physical characteristics that would be a significant impediment to emergency planning. Id.; Staff Exh. 1 (SER) at 13-6.

119. In addition, as stated in SSAR Section 13.3.3, during the preparation of the Dominion's Application, Dominion met with the Virginia Department of Emergency Management ("VDEM") and response organizations. Dom. Exh. 9 (Dom. Safety Test.) at 27. During these discussions, no impediments to the ESP were identified by the VDEM or response organizations. Id. Subsequently, Dominion provided revised letters of agreement from the emergency response agencies acknowledging the agencies' awareness of Dominion's Application and stating that the existing agency arrangements would apply to prospective additional reactors at the site. Id.; Staff Exh. 1 (SER) § 13.3.2.1. The NRC Staff has reviewed this information and concluded that the description of contacts and arrangements made with Federal, State, and local government agencies with emergency planning responsibilities is acceptable and meets the requirements of 10 C.F.R. § 52.17(b)(3). Staff Exh. 1 (SER) at 13-8.

120. Pursuant to 10 C.F.R. § 52.17(b)(2)(i), the major features of the emergency plan were described in the SSAR. These features of the plan are based on Supplement 2 to NUREG-0654/FEMA-REP-1, Revision 1, "Criteria for Preparation and Evaluation of Radiological Emergency Response Plans and Preparedness in Support of Nuclear Power Plants—Criteria for Emergency Planning in an Early Site Permit Application—Draft Report for Comment," issued April 1996. Dom. Exh. 9 (Dom. Safety Test.) at 28; Dom. Exh. 11, SSAR § 13.3.2.2. The major features take advantage of the emergency planning resources, capabilities, and organization already established and currently maintained at NAPS. Id. There are no significant differences between the major features proposed in Dominion's Application and the major features of the existing plans. Id.

121. A plume exposure pathway emergency planning zone ("EPZ") of about 10 miles in radius and an ingestion pathway EPZ of about 50 miles in radius were identified. Dom. Exh. 9 (Dom.

Safety Test.) at 28. This is consistent with the NAPS Emergency Plan and its associated offsite emergency plans. Id.; Staff Exh. 1 (SER) at 13-10.

122. Supplement 2 to NUREG-0654/FEMA-REP-1, Revision 1, provided evaluation criteria for 14 of the 16 emergency planning standards enumerated in 10 C.F.R. § 50.47(b) which were applicable at the ESP application stage. The following 13 major features were determined to be acceptable and meet the requirements of 10 C.F.R. § 52.17(b)(2)(i) and 10 C.F.R. § 52.18, and applicable elements of Appendix E to 10 C.F.R. Part 50:

- Major Feature A, Assignment of Responsibility—Organization Control
- Major Feature B, Onsite Emergency Organizations
- Major Feature C, Emergency Response Support and Resources
- Major Feature D, Emergency Classification System
- Major Feature E, Notification Methods and Procedures
- Major Feature F, Emergency Communications
- Major Feature G, Public Education and Information
- Major Feature I, Accident Assessment
- Major Feature J, Protective Response
- Major Feature K, Radiological Exposure Control
- Major Feature L, Medical and Public Health Support
- Major Feature O, Radiological Emergency Response Training
- Major Feature P, Responsibility for the Planning Effort—Development, Periodic Review, and Distribution of Emergency Plans

Dom. Exh. 9 (Dom. Safety Test.) at 28, 29; Staff Exh. 1 (SER) at 13-8 to 13-59.

123. Major Feature H, Emergency Facilities and Equipment, was not evaluated as part of Dominion's Application because it was deemed premature. Dom. Exh. 11, SSAR § 13.3.2; Dom. Exh. 9 (Dom. Safety Test.) at 29; Staff Exh. 1 (SER) at 13-32 to 13-34.

f. Security

124. 10 C.F.R. § 100.21(f) requires that site characteristics must be such that adequate security plans and measures can be developed. As discussed in Section 13.6 of the SSAR, the characteristics of the ESP Site are such that implementation of the applicable requirements of 10

C.F.R. § 73.55 and RG 4.7, as well as the post-9/11 NRC Orders, can be met. Dom. Exh. 11, SSAR § 13.6. See Dom. Exh. 9 (Dom. Safety Test.) at 29. The NAPS site is sufficiently large to provide adequate distances between structures and the probable location of a security boundary. Dom. Exh. 9 (Dom. Safety Test.) at 29. For the existing units, Virginia Power has a security program in place in compliance with the NRC Order for Interim Compensatory Measures, dated February 25, 2002, that addresses waterborne threats to the site without the need to restrict access to the Lake. Id. In the event that new units are added to the site, it is anticipated that those requirements would continue to be met. Id. The ESP Site characteristics would allow an applicant for a COL or CP to develop adequate security plans and measures for a reactor(s) that it might construct and operate on the ESP Site. Staff Exh. 1 (SER) at 13-62.

125. Further, Dominion's Safety Testimony and Section 13.3 of the SSAR indicate that Dominion has satisfied the NRC's requirements regarding emergency planning as set forth in 10 C.F.R. §§ 100.20(a), 100.21(g), and 52.17(b)(1). Dom. Exh. 9 (Dom. Safety Test.) at 27-29; Dom. Exh. 11, SSAR § 13.3. SER Section 13.3 demonstrates that the NRC Staff adequately reviewed the record with respect to this issue and found that Dominion has satisfied the relevant criteria.

3. Conclusion on Safety Issue 1

126. As indicated in the findings above, the NRC Staff has carefully reviewed Dominion's Application and conducted many independent or confirmatory analyses.[26] The scope of and bases for the Staff's review were guided by RS-002, which reflects many years of experience. Staff Exh. 1 (SER) at 1-2. During its review, the NRC Staff asked Dominion to respond to

[26] The Board notes that the NRC Staff is not required to verify independently all of the factual assertions in an application. Rather, the Staff uses an audit system which allows it to prioritize which facts it will independently verify, Clinton, CLI-07-12, slip. op. at 5. As the Commission has stated, "we fully expect our Staff to continue to utilize our long-standing regulatory practice of verifying only facts as necessary, based on its expert judgment. . ." Id. at 6.

eleven sets of RAIs related to the SSAR, containing about 115 questions. Dom. Exh. 9 (Dom. Safety Test.) at 6. The NRC Staff's SER and SER Supplement review comprehensively and explain the bases for the NRC Staff's conclusions with respect to all of the siting criteria. Id. The ACRS Report supports the sufficiency of the NRC Staff's review. The ACRS concurs with the NRC Staff's conclusions. Staff Exh. 1 (SER) at E-4.

127. Accordingly, based on the foregoing findings, the Board finds that Dominion's Application and the record of the proceeding contain sufficient information, and the review of the Application by the NRC Staff has been adequate to support a finding that the issuance of the ESP will NOT be inimical to the common defense and security or to the health and safety of the public.

B. Safety Issue 2

128. With respect to Safety Issue 2, the Board must decide whether the application and the record of the proceeding contain sufficient information, and the review of the application by the NRC Staff has been adequate to support a finding that, 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.

129. The health and safety matters implicated by Safety Issue 2 are the same health and safety matters addressed with respect to Safety Issue 1 above. For the same reasons as those set forth above, the Board finds that the application and the record of the proceeding contain sufficient information, and the review of the application by the NRC Staff has been adequate to support a finding that, 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.

IV. Findings on NEPA Issues

130. The Board must decide whether the review conducted by the Commission pursuant to NEPA has been adequate. This determination is largely satisfied by affirmative findings on each of the three baseline NEPA issues. Therefore, the baseline issues are addressed first below, followed by the general issue.

A. NEPA Baseline Issue 1

131. In order to satisfy NEPA Baseline Issue 1, the Board must decide whether the requirements of Section 102(2)(A), (C), and (E) of NEPA and Subpart A of 10 C.F.R. Part 51 have been complied with in the proceeding.

1. Compliance with 102(2)(A)

132. Section 102(2)(A) of NEPA requires all federal agencies to "utilize a systematic and interdisciplinary approach which will insure the integrated use of natural and social sciences and environmental design arts in planning and decisionmaking which may have an impact of man's environment." 42 U.S.C. § 4332(2)(A). The FEIS is prima facie evidence that this requirement is met. The FEIS analyzes numerous diverse topics relating to both construction and operation, including land use impacts, meteorological and air quality impacts, water-related impacts, ecological impacts, socio-economic impacts, historic and cultural resources, environmental justice impacts, non-radiological impacts, and radiological impacts. Staff Exh. 3 (FEIS), Ch. 4-5. These analyses were prepared by engineers, scientists, and social scientists with expertise in diverse disciplines, as shown in Appendix A to the FEIS. In addition, the NRC Staff contacted and consulted with numerous agencies and organizations with relevant expertise, as shown in Appendices B and C to the FEIS.

133. Dominion's expert witnesses, Ms. Patterson and Mr. Cudworth, testified that the NRC Staff's NEPA review of Dominion's ESP application was systematic and interdisciplinary, as reflected by the numerous topics analyzed in the FEIS, the long list of reviewers, and the scope of the consultations that were conducted. Dom. Exh. 10 (Dom. Env. Test.) at 12. Mr. Cudworth holds Bachelor and Master of Science degrees in Resources Development as well as a law degree and has 30 years of professional experience in environmental reviews under NEPA, including involvement in preparing thirty-six environmental reports supporting NRC licensing actions and fifteen environmental impact statements for the Department of Energy and other federal agencies. Id. at 2. Ms. Patterson holds Bachelor and Master of Arts degrees in Biology and has 30 years of professional experience as a project manager and an environmental scientist with expertise in NEPA. Id. Her experience includes involvement in the preparation of twenty environmental reports supporting NRC licensing actions, and six environmental impact statements for the Department of Energy. Id. Consequently, these witnesses are well qualified experts whose opinion is entitled to substantial weight.

2. Compliance with 102(2)(C)

134. Section 102(2)(C) of NEPA requires that a Federal agency address in its environmental impact statement: (1) the environmental impact of the proposed action; (2) any adverse environmental effects which cannot be avoided should the proposal be implemented; (3) alternatives to the proposed action; (4) the relationship between local short-term uses of man's environment and the maintenance and enhancement of long-term productivity; and (5) any irreversible and irretrievable commitments of resources which would be involved in the proposed action should it be implemented. 42 U.S.C. § 4332(2)(C).

135. Again, the FEIS is itself prima facie evidence that NEPA Section 102(2)(C) was satisfied. The FEIS contains a detailed statement regarding the five issues set forth in Section 102(2)(C)(i)-(v). In particular, the NRC Staff examined the potential environmental impacts associated with the construction, operation, and decommissioning of a reactor(s) having characteristics that fall within the parameters of the site in FEIS Chapter 4 (Construction Impacts); Chapter 5 (Operational Impacts); Chapter 6 (Impacts of Fuel Cycle, Transportation, and Decommissioning); and Chapter 7 (Cumulative Impacts). Staff Exh. 3 (FEIS). Unavoidable adverse impacts are analyzed in Chapter 10.2 of the FEIS. Id. at 10-5 to 10-9. Chapters 1, 8, and 9 of the FEIS address reasonable alternatives, including the no-action alternative. Staff Exh. 3 (FEIS) Ch. 1, 8 and 9. See also Dom. Exh. 10 (Dom. Env. Test.) at 13; Tr. 572 (Kugler). Finally, Chapter 10 of the FEIS addresses both the relationship between local short-term uses of man's environment and the maintenance and enhancement of long-term productivity, and any irreversible and irretrievable commitment of resources that might result from the proposed action.[27] Staff Exh. 3 (FEIS) at 10-9 to 10-10.

136. Dominion's witnesses, Ms. Patterson and Mr. Cudworth, provide an expert opinion that the NRC Staff has taken the "hard look" at the environmental impacts required by NEPA.[28] Dom. Exh. 10 (Dom. Env. Test.) at 12. The NRC Staff review started from the information presented in the ER, included numerous consultations, independent analyses, and consideration of agency and public comments, and culminated in the FEIS providing over 400 pages of analysis of the five Section 102(2)(C) issues. Id.

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[27] The Commission has held that short-term damage cannot be weighed against long-term benefits until the COL stage, and similarly an assessment of the irretrievable commitment of resources – i.e. construction resources – will not be known until a particular design is selected. Grand Gulf, CLI-07-14, slip. op. at 3. The Commission held that the NRC Staff's deferral of these issues is consistent with NEPA's requirements. Id. at 4.

[28] Louisiana Energy Services, L.P. (Claiborne Enrichment Center), CLI-98-3, 47 N.R.C. 77, 88-89 (1998), quoting Public Utilities Commission v. FERC, 900 F.2d 269, 282 (D.C. Cir. 1990).

137. While the adequacy of the assessment of impacts in the FEIS is supported both by the FEIS on its face and by the expert opinion of Dominion's witnesses, and indeed there is no evidence in the record to the contrary, the Board nevertheless probed a number of issues to assure itself that the NRC Staff had taken the requisite "hard look." The Board's inquiries focused on four issues: (1) the completeness of the Environmental Report (i.e., whether it was permissible for certain issues not to be resolved); (2) surface water impacts; (3) groundwater impacts; and (4) environmental justice.

a. Completeness of Environmental Review

138. Other than certain issues that are not required to be considered in an ESP proceeding -- need for power,[29] alternative energy sources,[30] and severe accident mitigation alternatives[31] -- there are six issues that are characterized in the FEIS as unresolved. These six issues are: (1) water quality; (2) design and severe accident impacts for gas-cooled reactors; (3) fuel cycle and solid waste impacts for gas-cooled reactors; (4) transportation impacts for gas cooled reactors; (5) decommissioning; and (6) chronic effects of electromagnetic fields. Dom. Exh. 3 at 1 (response to environmental question 1A).

139. With respect to water quality, Dominion's PPE provides the maximum concentrations of anticipated constituents in the blowdown discharges for the Unit 3 Closed-Cycle, Dry and Wet Tower and for the UHS Mechanical Draft Cooling Towers. Dom. Exh. 11, SSAR at 3-3-40. Table 3.3-1 of the Environmental Report (id. at 3-3-52) shows that the estimated combined volume of other plant releases is an order of magnitude smaller than the release from cooling

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[29] See 10 C.F.R. § 52.17(a)(2).

[30] Clinton, CLI-05-17, 62 N.R.C. at 48.

[31] See id. ("At the ESP stage of the construction permit process, the boards' 'reasonable alternatives' responsibilities are limited because the proceeding is focused on an appropriate *site*, not the actual construction of a reactor. Thus, boards must merely weigh and compare alternative sites, not other types of alternatives (such as alternative energy sources).") (emphasis added) (footnote omitted). See also NRC letters dated Feb. 12, 2003 (ML030280518) and June 25, 2003 (ML031430282).

tower blowdown. As noted in Section 3.6.1 of the ER (id. at 3-3-81), the other discharges would be treated, but might still contain low-level chemicals or biocides similar to effluents from the existing units. Section 3.6.1 of the ER identifies the typical chemicals that might be present. Id. Thus, other waste streams are minor in comparison to the blowdown, and their constituents are unlikely to exceed the values and parameters provided for the cooling tower blowdown in Table 3.1-9 of the ER. Sections 5.2.2.5 and 5.5.1.1 of the ER state that these discharges would meet applicable VPDES permit limits and water quality standards. Id. at 3-5-20, 3-5-152. Dominion concludes that potential impacts of constituents in plant effluent would be small as noted in ER § 5.3.2.2.2b (id. at 3-5-61) and 5.5.1.1 (id. at 3-5-152). Dom. Exh. 3 at 2, 18-19 (response to environmental questions 1A and 26).

140. Based on this information, the NRC Staff, in Section 5.3.3 of the FEIS, agrees that water quality impacts are likely to be small. Staff Exh. 3 (FEIS) at 5-13.[32] However, as stated in Section 5.3.3 of the FEIS, this issue is characterized as unresolved because concentrations of waste streams other than Unit 3 blowdown have not been defined. Id. The reason is that design level information is not available. Staff Exh. 10 at 1 (response to environmental question 1A).

141. With respect to accidents, the analysis of design basis accidents and severe accidents in the ER and FEIS is based on three light water reactor ("LWR") designs: the AP1000, ABWR, and ESBWR. Because of their greater potential for inherent safety, the accident radiological consequences of the other reactors, including the gas-cooled reactors, are expected to be bounded by the AP1000, the ABWR, and the ESBWR. See, e.g., Staff Exh. 3 (FEIS) at 5-73 ("the potential consequences of accidents for other reactor designs are expected to be bounded by

[32] Indeed, the Board notes that in the NRC rules governing license renewal, the NRC has determined generically that the impacts from discharge of chlorine and biocides, discharge of sanitary wastes, and discharge of metals in waste water are small for all plants. 10 C.F.R. § Part 51, App. B, Table B-1.

those for the ABWR, surrogate AP1000, and surrogate ESBWR designs."). Moreover, because the gas-cooled reactors are small modular units, there would have to be core damage and containment failures at multiple modules for a severe accident at a gas-cooled unit to be comparable to the large LWRs. Dom. Exh. 3 at 2 (response to environmental question 1A). However, these impacts are characterized as unresolved for gas-cooled reactors in Section 5.10.3 of the FEIS due to insufficient information concerning the gas-cooled designs. Staff Exh. 3 (FEIS) at 5-90; Staff Exh. 10 at 2 (response to environmental question 1A). If a COL applicant were to select a gas-cooled reactor, it would have to demonstrate that the environmental impacts of accidents remained bounded by environmental impacts of the surrogate designs. Staff Exh. 3 (FEIS) at 5-77, 5-89.

142. With respect to Fuel Cycle Impacts and Solid Waste Management, the impacts relating to gas-cooled reactors are estimated in Section 6.1.2 of the FEIS based on the currently available information on fuel design, transportation packages, and other pertinent characteristics. See Staff Exh. 3 (FEIS) at 6-17, Table 6-3 ("Fuel Cycle Environmental Impacts from Gas-Cooled Reactor Designs for the North Anna ESP Site"). The FEIS concludes that the impacts from mining, milling and conversion for gas-cooled reactors would be small. Id. at 6-19. The FEIS also concludes that the impacts from fuel fabrication, enrichment and waste management would likely be small. Staff Exh. 3 (FEIS) at 6-18 to 6-20. The NRC Staff categorizes these assessed impacts as unresolved because of the uncertainty in the final design of the gas-cooled reactors and the change in technology that could be applied to uranium fuel cycle activities. Staff Exh. 3 (FEIS) at 6-20.

143. Similarly, with respect to transportation associated with gas-cooled reactors, Dominion provided a description and analysis as stated in the FEIS at 6-23, and Section 6.2 of the FEIS

included an assessment of these impacts. See Staff Exh. 3 (FEIS) at 6-27, Table 6-5 (showing among other things radiological impacts of transporting gas-cooled reactor fuel); 6-29 ("the staff concludes that the impacts of [transportation] accidents involving unirradiated gas-cooled reactor fuel would likely not be significantly different than for unirradiated LWR fuel and will be within the impacts listed in Table S-4 for current generation LWRs."); 6-32, Table 6-6 (providing, among other things, radiation doses associated with the transportation of spent fuel for gas-cooled reactors); 6-38, Table 6-9 (providing, among other things, annual spent fuel accident impacts for gas cooled reactors); 6-40, Table 6-10 (summarizing, among other things, waste shipments for gas-cooled reactors). Dom. Exh. 3 at 2 (response to environmental question 1A). The NRC Staff concludes that for gas-cooled designs, the impacts are likely to be small, but characterizes the issue as not resolved because of the lack of verifiable information on the designs. Staff Exh. 3 (FEIS) at 6-39, 6-41.

144. With respect to decommissioning impacts, both the ER and FEIS reference NUREG-0586, Supplement 1, which provides a generic evaluation of the environmental impacts of decommissioning. See Dom. Exh. 11, ER § 5.9; Staff Exh. 3 (FEIS) § 6. See also Dom. Exh. 3 at 2 (response to environmental question 1A). The FEIS concludes that these impacts are likely small, but characterizes this impact as unresolved until a final design is selected. Staff Exh. 3 (FEIS) at 6-42.

145. Both Dominion's ER and the NRC's FEIS discuss the current state of scientific knowledge with respect to whether chronic effects of EMF occur. In October 1996, a National Research Council committee of the National Academy of Sciences (NAS) released its evaluation of research on potential associations between EMF exposure and cancer, reproduction, development, learning, and behavior. As discussed in ER Section 5.6.3.2, NAS concluded:

> Based on a comprehensive evaluation of published studies relating to the effects of power-frequency electric and magnetic fields on cells, tissues, and organisms (including humans), the conclusion of the committee is that the current body of evidence does not show that exposure to these fields presents a human-health hazard. Specifically, no conclusive and consistent evidence shows that exposures to residential electric and magnetic fields produce cancer, adverse neurobehavioral effects, or reproductive and developmental effects.

Dom. Exh. 11, ER at 3-5-162; Dom. Exh. 3 at 8 (response to environmental questions 5B). More recently, a report by the National Institute of Environmental Health Sciences ("NIEHS") in 1999 concluded that EMF cannot be recognized as entirely safe because of weak scientific evidence that exposure may pose a leukemia hazard. The report stated that this finding was insufficient to warrant aggressive regulatory concern, and that the NIEHS does not believe that other cancers or non-cancer health outcomes provide sufficient evidence of a risk to currently warrant concern. The NRC Staff has evaluated this statement and determined that the potential impact should not be considered significant. Staff Exh. 3 (FEIS) at 5-57 to 5-58 (Section 5.8.5). However, because the evidence is not conclusive, the NRC Staff categorizes the issue as unresolved, so that the state of scientific evidence will be considered again in any COL proceeding. Id.

146. Thus, Dominion and the NRC Staff have addressed each of these issues either through evaluations based on PPE information or through evaluations based on information reasonably available. However, the NRC Staff is declining to make a final determination that might otherwise be subject to issue preclusion under 10 C.F.R. § 52.39(a)(2). Thus, categorizing these impacts as unresolved does not imply that these impacts have been ignored, but instead preserves the NRC's ability to evaluate these issues again in any COL proceeding.

147. The Board asked the parties to respond to a number of questions exploring whether such unresolved issues are permissible under the NRC regulations and NEPA. Based on the responses

to these questions and oral argument at the hearing, the Board is satisfied the Dominion and the NRC Staff have fully complied with their obligations under the rules and NEPA.

148. At the outset, we note that a recent decision of the U.S. Court of Appeals for the 7th Circuit holds that it is permissible under NEPA to defer environmental issues from the ESP to COL stage:

> Because an ESP does not authorize construction, the evaluations conducted at the ESP stage are intended to provide early resolution of some – but not all – environmental issues. 10 C.F.R. §§ 52.79(a)(1) and 52.89 (stating that "any significant environmental issue not considered" at the ESP stage must be addressed when the holder of an ESP applies to commence construction).... [T]he agency regulations at issue are not inconsistent with environmental law, because all relevant issues will eventually be considered. Courts have permitted agencies to defer certain issues in an EIS for a multistage project when detailed useful information on a given topic is not "meaningfully possible" to obtain, and the unavailable information is not essential to determination at the earlier stage. *See, e.g., County of Suffolk v. Sec'y of the Interior,* 562 F.2d 1368, 1378 (2d Cir. 1972).

Envtl. Law & Policy Ctr. v. NRC, 470 F.3d 676, 684 (7th Cir. 2006).

149. More generally, it is well established that NEPA does not require federal agencies to resolve all uncertainties. Indeed, as one court has stated, "[i]f we were to impose a requirement that an impact statement can never be prepared until all relevant environmental effects were known, it is doubtful that any project could ever be initiated." Jicarilla Apache Tribe of Indians v. Morton, 471 F.2d. 1275, 1280 (9th Cir. 1973). Thus, in Baltimore Gas & Elec. Co. v. NRDC, 462 U.S. 87, 88, 98-100, 101-02 (1983), the Supreme Court held that NRC complied with NEPA's requirements of consideration and disclosure where it summarized major uncertainties and found the evidence tentative but favorable.

150. Further, while a bounding analysis is one method of addressing uncertainty, it is not the only approach permissible under NEPA.

> An agency can [consider the environmental risks of a proposed action] by having the appropriate decisionmakers consider all that is known and unknown about the risks before deciding whether to take an action. Or it can organize its decisionmaking process in such a manner that the appropriate decisionmakers consider only the upper bound of reasonably foreseeable environmental costs.... Either method of considering and disclosing uncertainties surrounding an environmental effect is acceptable under NEPA.

NRDC v. NRC, 685 F.2d 459, 486 (D.C. Cir. 1982). Thus, in Baltimore Gas, the Supreme Court upheld the NRC's analysis of uncertainties where the NRC had "estimate[d] its impacts conservatively, based on the best available information and analysis." 462 U.S. at 102.[33]

151. The Council on Environmental Quality ("CEQ") regulations at 40 C.F.R. § 1502.22 provide guidance for addressing incomplete or unavailable information in an EIS. The CEQ regulations advise that when information is incomplete or unavailable (because the overall costs of obtaining it are exorbitant or the means to obtain it are not known), an EIS should include a statement that the information is incomplete or unavailable, explain the relevance of the missing information, summarize the existing evidence, and evaluate the impacts using generally accepted methods. See 40 C.F.R. § 1502.22(b).

152. This CEQ regulation "requires that analysis of impacts in the face of unavailable information be grounded in the 'rule of reason.'" 51 Fed. Reg. 15,618, 15,621 (Apr. 25, 1986). As CEQ explained,

> The "rule of reason" is basically a judicial device to ensure that common sense and reason are not lost in the rubric of regulation. The rule of reason has been cited in numerous NEPA cases for the proposition that, "An EIS need not discuss remote and highly speculative consequences. . . . This is consistent with the (CEQ) Council on Environmental Quality Guidelines and the frequently expressed view that adequacy of

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[33] In holding that the NRC's promulgation of Table S-3 did not violate NEPA, the Supreme Court noted:

> [T]he Commission's staff did not attempt to evaluate the environmental effects of all possible methods of disposing of waste. Rather, it chose to analyze intensively the most probable long-term waste disposal method – burial in a bedded-salt repository several hundred meters under ground – and then "estimate its impact conservatively, based on the best available information and analysis."

462 U.S. at 102 (citation omitted).

> the content of the EIS should be determined through use of a rule of reason." Trout Unlimited v. Morton, 509 F.2d 1276, 1283 (9th Cir. 1974). In the seminal case which applied the rule of reason to the problem of unavailable information, the court stated that, "[NEPA's] requirement that the agency describe the anticipated environmental effects of a proposed action is subject to a rule of reason. The agency need not foresee the unforeseeable, but by the same token, neither can it avoid drafting an impact statement simply because describing the environmental effects of alternatives to particular agency action involves some degree of forecasting . . . 'The statute must be construed in the light of reason if it is not to demand what is, fairly speaking, not meaningfully possible . . .' " Scientists' Institute for Public Information, Inc. v. Atomic Energy Commission, 481 F.2d 1079, 1092 (D.C. Cir. 1973), citing Calvert Cliffs' Coordinating Committee v. Atomic Energy Commission, 449 F.2d 1109, 1114 (D.C. Cir. 1971).

Id.

153. Here, the uncertainties are largely the result of the absence of plant specific engineering (particularly with regard to gas-cooled reactor designs that are still conceptual) or operational decisions that have not yet been made. Dominion and the NRC Staff have assessed each of the issues based on the information that is currently available. The FEIS contains a discussion of the relevance of the issues to the environmental impacts analysis and evaluates the available information using generally accepted methods. It clearly comports with the rule of reason and thus is both complete under NEPA and complete under the NRC's rules.

154. Moreover, the Commission's recent decision in the Grand Gulf ESP proceeding indicates that it is permissible to defer final resolution of issues.

> [A]n assessment of the irretrievable commitment of resources – *i.e.*, construction resources – will not be known until a particular reactor design is selected. Because the Staff merely deferred these narrow questions to a time when they can be accurately assessed, we find the Staff's actions consistent with NEPA's requirements.

Grand Gulf, CLI-07-14, slip op. at 3-4.

155. The Board also notes that the Commission has recently approved a final rule to amend Part 52,[34] and the Statement of Considerations approved by the Commission "clarifies" the Commission's intent regarding the scope of environmental review in ESP proceedings.

> The NRC is making additional changes to § 51.50(b) to further clarify the scope of the environmental review at the early site permit stage. . . . The purpose of this change is to clearly delineate that the scope of the environmental review at the early site permit stage is, at a minimum, to address all issues needed for the NRC to perform its evaluation of the alternative sites. In addition, the applicant may choose to address one or more issues related to construction and operation of the facility with the goal of achieving finality on those issues at the early site permit stage.

SECY-06-0220, Encl. 1 at 281-82. Thus, environmental information in an ESP proceeding should be deemed sufficient if it allows evaluation of alternative sites.

156. Similarly, in its response to public comments in this rulemaking, the Commission explained the relationship between environmental reviews at the ESP and COL stage:

> [T]he Part 52 licensing model, with respect to ESPs and COLs referencing them, is akin to evaluation of a project at an early stage, with subsequent evaluation at a later stage, as described in the CEQ regulations at 40 C.F.R. § 1508.28(b). As indicated in § 1508.28(b), such a process is appropriate when it helps the agency to focus on the issues that are ripe for decision and exclude from consideration issues already decided or not yet ripe. The Commission intends to focus its environmental reviews in a similar manner. Accordingly, the Commission concludes that the final rule will ensure compliance with NEPA.

SECY-06-0220, Enclosure 3 at 133-34.

157. Further analysis of the issues characterized as unresolved is not essential to the evaluation of alternative sites. The NRC Staff was able to evaluate alternative sites based on the information presented in the ER and FEIS. It should be noted that two of the unresolved issues – fuel cycle and solid waste impacts for gas-cooled reactors, and transportation impacts for gas-cooled reactors, are generic impacts common to all plants. Therefore, they can have no effect on

[34] Staff Requirements Memorandum (Apr. 11, 2007)

the evaluation of alternative sites. The NRC Staff also determined that non-radiological health impacts and environmental impacts from postulated accidents do not influence the comparison of impacts between North Anna and the alternative sites. Staff Exh. 3 (FEIS) at 9-2. Similarly, the NRC Staff concludes that the impacts from decommissioning are likely to be not only small but to affect all sites in a similar manner. Id.

158. Indeed, all of the unresolved issues were estimated to be likely small. In Izaak Walton League of Am. v. Marsh, 655 F.2d 346, 377 (D.C. Cir.), cert. denied, 454 U.S. 1092 (1981), the Court held that an agency was not required to conduct a major study to better quantify biological impacts when it had concluded that the impacts were minor. As the Court explained:

> Detailed analysis is required only where impacts are likely. . . . Where adverse impacts are not likely, expensive and time-consuming studies are unnecessary. So long as the environmental impact statement identifies areas of uncertainty, the agency has fulfilled its mission under NEPA.

Id. Accordingly, the Board finds that the resolution of issues in the FEIS is consistent with both NEPA and the NRC rules.

b. Surface Water Impacts

159. The Board inquired concerning surface water impacts both in its written questions and during the presentations at the oral hearing. There were two reasons for this inquiry. First, surface water impacts had originally been raised as a contention; and although that contention had focused on thermal impacts that were resolved with Dominion's decision to employ closed-cycle cooling, it reflected an underlying sensitivity to the potential impact on fish such as striped bass. Second, the Board was interested in understanding whether Dominion's commitment to the Virginia Department of Environmental Quality to perform an Instream Flow Incremental Methodology ("IFIM") study had any implications concerning the adequacy of the environmental assessment of surface water impacts.

160. To assess surface water impacts, Dominion and the NRC Staff each independently modeled water budget impacts. The NRC Staff's review is described in Appendix K to the FEIS (Staff Exh. 3 (FEIS), App. K). The NRC Staff's model predicts that the percent of time that Lake Anna would be at or below 248 feet msl and the discharge of the dam would be at 20 cfs[35] would increase from about 6 to 11 percent. Staff Exh. 3 (FEIS), App. K at K-10; Tr. 78 (Ward). Dominion's model is described in Section 5.2.2.1 of the ER. Dom. Exh. 11, ER § 5.2.2.1. Dominion's model predicts that the frequency of the lake level dropping below 248 feet and 20 cfs flows at the dam would increase from about 5 percent of the time to 7 percent of the time. Dom. Exh. 11, ER at 3-5-16; Tr. 139, 143 (Taylor).

161. The Board explored why Dominion's and the NRC Staff's estimates differ. Both Dominion and the NRC Staff agree that the NRC Staff's analysis is more conservative because the NRC Staff's model used a fixed, average evaporation rate of 8707 gpm applied over the entire period of analysis. Tr. 70, 118-19 (Vail); Tr. 140-42 (Taylor). As explained in Dominion's response to the Board's environmental question 48, the conservatism in the NRC Staff's analysis is a result of using an average evaporation rate (8707 gpm) that exceeds the expected evaporative loss induced by the new units when lake level is below EL 250 ft (76.2 m) msl. As described in FEIS Section 3.2.2 and in ER Section 3.4.1.1, the proposed Unit 3 would use a closed-cycle, combination wet and dry cooling tower system. The wet towers would be used primarily to cool Unit 3 during periods of relative water surplus, which are defined as periods when the water surface elevation of Lake Anna is at or above EL 250 ft (76.2 m) msl. During periods when the elevation of Lake Anna is below 250 ft (76.2 m) msl for a period of

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[35] Under the Lake Level Contingency Plan, Dominion must reduce the discharge from the North Anna dam to 20 cfs when the lake level drops at or below 248 feet. Dom. Exh. 11, SSAR at 2-2-114 and ER at 3-2-22. This requirement is a condition in NAPS VDPES permit. Tr. 174-75 (White).

seven or more consecutive days, Unit 3 would be cooled with a closed-cycle, combination wet and dry cooling tower system to limit consumptive water use. In this mode, all or part of the excess heat generated by Unit 3 operation would be dissipated using a dry cooling tower which would have minimal, if any, evaporative losses. If atmospheric conditions were such that Unit 3 dry cooling towers could not completely cool the circulating water, wet towers would be employed to dissipate the remaining excess heat. The use of the average value to represent the evaporative loss from the new units therefore, overestimates the percentage of time that the lake level would drop below EL 248 ft msl. Dom. Exh. 3 at 33 (response to environmental question 48).

162. In contrast, Dominion's model was more realistic, because it modeled the anticipated mode of operation of the proposed cooling system. Tr. 140-41 (Taylor). Rather than using the annual average evaporation, Dominion took credit for the full extent of dry cooling tower operation during the periods in which it would be operated – i.e., when the lake level is below 248. Tr. 141 (Taylor). Dominion's water budget model predicts weekly lake levels and outflows, the releases from the North Anna Dam, on a weekly basis for a 24-year period of record. Tr. 138 (Taylor). The NRC Staff agreed that Dominion's model employed short-term characteristics of the specific cooling system design, which allowed its analysis to take credit for the reduced water use that occurs in periods of low lake level during favorable atmospheric conditions. Tr. 70 (Vail). Based on this testimony, the Board is satisfied that Dominion's projection more accurately reflects the increase in frequency of reduced lake levels and downstream flows resulting from the proposed cooling system for the third unit. In particular, Dominion's projections show that a 2 percent increase in the frequency of 20 cfs outlfow represents the environmental impact from Unit 3 operation as proposed that cannot be avoided without further mitigation measures.

163. The Board also notes that this projection is inherently conservative because the water budget analysis is based on a 24-year simulation period that includes the two lowest years of precipitation in the extended period of record. Tr. 99 (Vail).

164. The NRC Staff examined the potential impact on the reservoir biota for a variety of impact categories related to the construction of Units 3 and 4 and the operation of Unit 3. The NRC Staff looked at the potential effects related to site runoff during construction, construction and operation of the intake structure including the impingement and entrainment of fish, 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 ESP Site. Tr. 75 (Masnik). Based on analysis of impact presented in the FEIS, the NRC Staff 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. 75-76 (Masnik).

165. The NRC Staff also considered the potential aesthetic and socioeconomic impacts associated with low lake levels. The NRC Staff determined that there would be a moderate and temporary impact on private lake front property views with water levels below 248 feet approximately, as observed during the 2001-2002 drought. Tr. 91 (Scott). However, property values would not be affected. Id.

166. The NRC Staff would expect moderate temporary impacts on boating and usability of private docks, boat houses and boat ramps, many of which are fixed facilities, as water levels fall below 248. Tr. 92 (Scott). However, as the NRC Staff testified, fishing was still possible and successful during the 2001-2002 drought. Likewise, the Lake Anna State Park, which is the major public facility, was able to use its launch ramps. Several of the marinas modified their launch ramps and their wet slips to operate at lower water. Some fishing guides had to move

their launch points, but were still able to find fish. Thus, the businesses were able to continue operating during the drought. Tr. 92 (Scott).

167. The NRC Staff assessed the impacts of Unit 3 to aquatic biota in the North Anna and Pamunkey Rivers, downstream of the North Anna Dam. It evaluated fish, invertebrates and aquatic and riparian plants. Tr. 76 (Ward). Because the low flow events do not coincide with spawning periods for most of these species, the impacts are expected to be small. Tr. 78 (Ward). The NRC Staff also evaluated potential impacts to benthic communities, aquatic plants and riparian vegetation common to downstream locations. The NRC Staff concluded that the impact of reduced flow to the addition of Unit 3 is expected to be undetectable. Tr. 81 (Ward). The NRC Staff acknowledged that the addition of Unit 3 would extend the low flow conditions, especially during drought events, but is of the opinion that the existing biota and plant assemblages have adapted to the existing flow regimes and are tolerate to occasional low flow conditions. Id. The NRC Staff witness, Dr. Masnik, testified that, particularly in east coast rivers, biota have evolved in such a way as to essentially flourish during periods of time when there are wide changes in flow. In essence, the biota are pre-adapted to weather periods of low water and thus are able to persist in these rivers. Tr. 100 (Masnik). Dr. Masnik testified that the changes from additional units would be within the normal variation that one would expect in a small river system like North Anna and in the southeastern part of the United States. Tr. 110-11 (Masnik). Biota inhabiting those streams are tolerant of large changes in flow and have flourished for quite some time under those circumstances. Tr. 111 (Masnik).

168. Dr. Masnik holds a Bachelor of Science degree in Conservation and Master of Science and Doctor of Philosophy degrees in zoology. Staff Exh. 11, Statement of Professional Qualifications of Michael Masnik. As reflected in his Statement of Professional Qualifications,

his career with the AEC and NRC has spanned over thirty years and includes extensive experience as a Fisheries Biologist. His expert opinion is therefore entitled to substantial weight.

169. The NRC Staff's conclusions are corroborated by Dominion's analyses and expert testimony. The effect of lowered flow on downstream aquatic species is addressed in Section 5.2.2.2 of the Environmental Report, and Section 5.4.2.6 of the FEIS. As discussed in these sections, to better quantify impacts to instream flows in the North Anna River, Dominion calculated the Indicators of Hydrologic Alteration ("IHA") for the outflow from the North Anna Dam under both pre- and post-impact conditions. The results indicate that there are no changes in the median 7-day, 30-day, and 90-day minimum flows as a consequence of adding Unit 3. The results do indicate greater variability in the minimum flows with the addition of Unit 3. The results also demonstrate that the Julian date of the annual maximum does not change significantly with the addition of Unit 3. Dom. Exh. 3 at 31 (response to environmental question 46). See also Dom. Exh. 11, ER at 3-5-17 to 3-5-18.

170. Dominion also examined how changes in flow at the dam would affect flow in the Pamunkey river. Tr. 147 (Ryan); Dom. Exh. 11, ER at 3-5-18; Dom. Exh. 3 at 32 (response to environmental question 46). Dominion looked at the Pamunkey because it is where spawning occurs. Tr. 150 (Ryan). Particular attention was given to spawning periods in April – May , but Dominion also evaluated the effects on an overall annual basis and on a summer and fall basis. Tr. 147, 148 (Ryan). With respect to the April - May period, the projected flow reduction (across all flows on a week by week basis) at the Hanover Gauge (which is upstream of the tidal region) would be in the 1 to 5 percent range. Tr. 146-47 (Ryan). See also Dom. Exh. 3 at 32 (response to environmental question 46). On an annual, summer, or fall basis, the five percent reduction also applied about 85 percent of the time. Tr. 148 (Ryan).

171. Based on Dominion's projections, the low flow (5 percent occurrence frequency, as 7-day running average) in April - May would be diminished from 207 to 206 cfs (0.5 percent difference). On an annual basis, the 5 percent low flow would be reduced from 80 cfs to 79 cfs, Dom. Exh. 3 at 32 (response to environmental question 46); Tr. 149 (Ryan). Thus, the impact at the low flows would be very small. Tr. 149 (Ryan). Similarly, in the April - May period, the median flow would be reduced from 851 cfs to 824 cfs (3 percent difference), while on an annual basis, the median flow would be reduced from 535 to 510 cfs. Dom. Exh. 3 at 32 (response to environmental question 46); Tr. 151-52 (Ryan).

172. Dominion then assessed the potential biological impact of this effect on river flows. Dom. Exh. 11, ER at 3-5-18; Dom. Exh. 3 at 32 (response to environmental question 42). Dr. Charles Coutant, who recently retired as a Distinguished Research Ecologist at the Oak Ridge National Laboratory (Dom. Exh. 15, Resume of C. Coutant), and who has acted as a consultant to Dominion on the ESP project (Tr. 152 (Coutant)), described this assessment. As reflected by his resume, Dr. Coutant is a well-qualified expert with over 40 years experience in evaluating the effects of power plants on aquatic species.

173. With respect to the impact on river communities generally, Dominion analyzed the 1979 to 2003 flow record, representing the flows that are experienced by the biological communities (all of the species in the North Anna River and the Pamunkey below the dam). The data demonstrate that the biological communities experience wide fluctuations in flow, both within a year and between years. Tr. 153 (Coutant). Most of the biological productivity and spawning activity in a system like this occurs in the spring when flows tend to be high. Tr. 153 (Coutant).

174. The biology of the community is protected by the mandated minimum (20 or 40 cfs) flows from the North Anna Dam, which are actually higher than the historical low flows. Id. Dr.

Coutant testified that in the upper part of the river – the free-flowing non-tidal reach – the studies have shown that the lower flows have not disrupted the benthic organisms, the insect larvae, and other food organisms for fish. Tr. 158 (Coutant). Therefore, Dr. Coutant's opinion is that the biological effects on the overall river communities would be small. Tr. 153 (Coutant).

175. Because they are species of interest (Tr. 150 (Coutant)), Dominion also specifically examined the potential impact on striped bass and American shad. With regard to striped bass, Dominion evaluated research work that has been done by the Virginia Institute of Marine Science ("VIMS") over a number of years, particularly since the 1980s, on the York River system, including both the Mattaponi and the Pamunkey. Dr. Coutant testified that it is clear from these studies that the spawning and early life stages of striped bass are in the tidal freshwater of the lower Pamunkey in April and May. There, the flows are dominated by tidal flows. Spawning occurs in the freshwater portion of the estuary, but tidal flow dominates over the flows from the freshwater inflow. Indeed, freshwater inflow really was not considered by the VIMS scientists as a particularly important variable in their studies. Tr. 154 (Coutant).

176. Dr. Coutant testified that striped bass accommodate wide year-to-year variations in the April to May flow. He testified that the freshwater inflow change of 1 to 5 percent in this April to May time would be insignificant for striped bass, when one considers the flows in which they historically and currently do well. Tr. 154 (Coutant). Indeed, as Dr. Coutant pointed out, the Mattaponi River, which has 50 percent of the average flow of the Pamunkey, has better striped bass production than does the Pamunkey. Tr. 155 (Coutant). Therefore, Dr. Coutant's opinion is that any impact on the reproduction and early life stages of striped bass would be small. Tr. 155 (Coutant). See also Dom. Exh. 11, ER at 3-5-18; Dom. Exh. 3 at 32 (response to environmental question 46).

177. With regard to the American shad, Dominion evaluated the studies by VIMS for both spawning and juvenile shad abundance in the York River system that have been conducted since 1979. Dr. Coutant testified that the juvenile indices for shad were generally higher when they experienced lower flows rather than the higher flows. He explained that the lower flows promote the retention of the eggs and larvae in the river. That same trend has been found in the Connecticut River and the Hudson River, where shad have also been studied extensively. Therefore, Dr. Coutant's opinion is that the reduction in this 1 to 5 percent in river flow in April and May would have a small and potentially positive effect on the juvenile shad production and survival. Tr. 156 (Coutant).

178. The Board questioned whether greater biological impacts might occur in the North Anna River. This question was addressed by Mr. Bolin, Dominion's Manager for Environmental Biology, who described the results of a 14 month study of the effects of low (cfs) flow on the North Anna River. Tr. 158-59 (Bolin). In essence, that study showed (1) no noticeable change in wetted perimeter, water depth or velocities; (2) temperature and dissolved oxygen following seasonal patterns; (3) no change in the aquatic insect community; and (4) no measurable changes in fish assemblage. Dom. Exh. 15 at 17; Tr. 161-63 (Bolin).

179. The Board also questioned whether recreational use of the river might be affected. There is some limited kayaking and canoeing in the North Anna River, but access is limited. There are a few public access points, but they are small. Tr. 188 (Bolin). As Dominion testified, the results of the low flow study, which showed that low flows had little impact on river parameters, indicate that any recreational impacts would be small. Tr. 187-88 (White). The NRC Staff similarly testified that its research did not indicate that levels of flow in the river had anything to do with the level of [recreational] activity that takes place. Tr. 109 (Scott).

180. The Board questioned whether the FEIS adequately addresses the potential conflicts over downstream water use. The Staff considered and quantified the potential impact that an added unit could have on the reliability of a hypothetical off-stream reservoir, Staff Exh. 3 (FEIS), § 5.3.2; Dom. Ex. 3 at 49 (response to environmental question 49). The Staff concluded that the estimated reliability of the reservoir would decrease from 95% to 90% with the addition of the consumptive water loss from Unit 3. Staff Exh. 3 (FEIS) at 5-11. The Staff concluded that this impact would be small in most years and moderate in drought years. Id. The Staff states that this potential conflict over water uses exists regardless of whether Unit 3 is constructed and is common. Id.; Staff Exh. 10 at 35-36 (response to environmental question 49). Dominion added that the Commonwealth of Virginia has established a comprehensive water supply planning process for the development of local, regional, and state water supply plans, and that measures to minimize downstream effects will be established by Dominion in cooperation with the Commonwealth in conjunction with State permitting. Dom. Exh. 3 at 34 (response to environmental question 49); Tr. 181-82 (White). The Board concludes that the impact of potential conflicts over downstream water use is adequately disclosed as required by NEPA.

181. Finally, the Board sought to understand better the reasons for the IFIM. As a condition of the Commonwealth of Virginia's concurrence with Dominion's certification under the Coastal Zone Management Act, Dominion committed to perform the IFIM, and this commitment will be incorporated into the ESP as a permit condition. The IFIM study is to be designed and monitored in cooperation and consultation with the Virginia Department of Game and Inland Fisheries and the Virginia Department of Environmental Quality. Tr. 84 (Masnik).

182. Dominion's Environmental Policy Manager, Dr. White, explained that the IFIM study is not being done to quantify any of the impacts for the FEIS, but to optimize state permit

decisionmaking related to how Dominion manages the lake and how the releases from the dams are handled. Tr. 164 (White). See also Dom. Exh. 3 at 32-33 (response to environmental question 46) ("The IFIM study is not being prepared in order to quantify environmental impacts for the environmental impact statement. The IFIM study is being conducted by Dominion for the VDEQ in order to establish parameters that the DEQ will use to establish the conditions for downstream flows and surface water management, in order to minimize any impacts.") In essence, although impacts are perceived as small, the Commonwealth is interested in this study to determine if any adjustments to the lake management should be made. Tr. 178-80 (White, Bolin). Indeed, as the NRC Staff observed, the study may result in changes to the dam release protocol to reflect more normative flows (i.e., even lower) in the North Anna River below the dam in late summer and fall. Tr. 89 (Masnik).

> [O]ne of the principle reasons why the IFIM study is being proposed is to determine whether or not it would be beneficial to go back to more normative flows, instead of keeping for example at 20 cfs or 40 cfs continually day and night for two or three months, there may be some benefit to the biota to vary that flow, let's say, down to 10 and then up maybe to 60. And, hopefully that study will shed some light on that question.

Tr. 111 (Masnik). The Board recognizes that this question is, in fact, independent from the impacts of new units.

183. The NRC Staff's testimony also indicates that the IFIM is not viewed as necessary for an assessment of the impacts of new units. As the NRC Staff testified, "[t]he Staff believe that the assessment that we've done to evaluate downstream impacts was thorough, reasonable and we're confident in our conclusions." Tr. 108 (Ward).

184. Accordingly, the Board concludes that Dominion's commitment to conduct the IFIM study does not indicate any inadequacy in the assessment of environmental impacts in the FEIS. The

Board recognizes that it is the State's prerogative, as the regulator of both discharges and withdrawals, to require studies unrelated to the NRC's assessment.

c. Groundwater Contamination

185. The Board probed whether the FEIS should have included an analysis of the impacts of potential groundwater contamination. The Board recognized that the Commission's decision in the Grand Gulf and Clinton ESP cases has accepted ESP Permit Condition 4 as obviating further analysis under 10 C.F.R. § 100.21(c)(3), but inquired whether such analysis might still be necessary under NEPA. Upon review of the testimony, the Board is now satisfied that a further analysis in the FEIS is not required, for several reasons.

186. First, the evidence shows that releases of radioactive effluent to groundwater are not a normal or planned pathway. Tr. 260-61 (Tarantino). Further, ESP Condition 4 will require that the radioactive waste management systems for a future reactor include features to preclude accidental releases of radionuclides into potential liquid ground water pathway. Thus, groundwater contamination is not expected.

187. Second, while accidents are also possible, the evidence shows that the likely impact of an accidental release would be insignificant. The ESP Site is hydrologically isolated from other groundwater users, because groundwater is relatively shallow at the site and surrounded by the Lake, arms of the Lake or tributaries of the Lake. Tr. 256 (Matthews). All groundwater flow from the ESP Site would be toward the Lake. Tr. 257 (Matthews). As discussed earlier in this decision, it would take at least sixteen years for groundwater to travel from the ESP Site to the Lake. Staff Exh. 1 (SER) at 2-127. Because Dominion has committed to monitor groundwater downgradient of the ESP Site (Tr. 272-73 (Tarantino), 274 (Hintz), 422 (Tarantino, Smith), 423-

24 (Smith)), it will have the ability to detect and ample time to respond to any release. Thus, any significant radiological consequences are unlikely.

188. Finally, Section 5.10 of the FEIS does discuss the radiological consequences of potential accidents at the ESP Site (defined as off-normal events not addressed in normal operations). Staff Exh. 3 (FEIS) at 5-70 and 5-71. Consistent with the guidance in the Environmental Standard Review Plan ("ESRP") (NUREG-1555, Chapters 7.0-7.2), the specific accidents analyzed are design basis accidents and severe accidents. Id. at 5-72 and 5-77. Thus, the FEIS analyzes a reasonable range of bounding accidents based on the guidance in the ESRP, which represents decades of experience in performing such reviews.

189. Accidental rupture of radioactive waste processing system components is not a design basis or severe accident. Tr. 381 (Dehmel). The NRC Staff testified that the FEIS analyzes accidents with greater consequences than the accidental release from radioactive waste processing systems. Tr. 644 (Bagchi). This analysis includes evaluation of pathways for dose from material deposited on the ground and in water. Staff Exh. 3 (FEIS) at 5-71 to 5-72. For design basis accidents, the regulatory standards and guides consider atmospheric pathways controlling. Id. at 5-73. The NRC Staff concludes for design basis accidents that the atmospheric pathway doses are low and the potential environmental impacts are small. Id. at 5-74. For severe accidents, the NRC Staff concludes that the surface water pathway contributes very little to the total risk compared to atmospheric pathways. Id. at 5-88. Because groundwater is a tortuous pathway and affords at least 16 years for implementing protective actions, the NRC Staff concludes that the groundwater pathway contributes less to risk than the atmospheric pathways and the risks associated with releases to groundwater are small for the ESP Site. Id. at 5-89. Therefore, the Board concludes that the analysis of design basis accidents and severe accident in the FEIS

bound any potential impacts from accidental releases of radioactive liquid because there would be ample time to respond to any contamination of groundwater before the accidental release could impact any member of the public.

190. In sum, the Board concludes that the FEIS need not discuss the potential for groundwater impacts for at least these three reasons: (a) negligible potential for any contamination of groundwater to occur undetected and reach off-site users; (b) a thorough evaluation of accidental releases that bound potential exposure through the groundwater pathway; and (c) a permit condition that further reduces the negligible potential for groundwater impacts from accidents. To the extent that a discussion of the negligible potential groundwater impacts would be informative for the discussion of environmental impacts, this decision amends the FEIS *pro tanto*.[36]

d. Environmental Justice

191. The Board questioned whether the NRC Staff discussed environmental justice ("EJ") in sufficient detail. The Board's inquiry was prompted by the Commission's Policy Statement on the Treatment of Environmental Justice Matters in NRC Regulatory and Licensing Actions, 69 Fed. Reg. 52,040 (Aug. 24, 2004), which states, "[i]f the percentage in the impacted area

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[36] In an adjudicatory hearing, to the extent that any environmental findings by the Presiding Officer (or the Commission) differ from those in the FEIS, the FEIS is deemed modified by the decision. Hydro Resources, Inc., CLI-01-04, 53 N.R.C. 31, 53 (2001), citing Philadelphia Electric Co. (Limerick Generating Station, Units 1 and 2), ALAB-819, 22 N.R.C. 681, 706-07 (1985); see also Niagara Mohawk Power Corp. (Nine Mile Point Nuclear Station, Unit 2), ALAB-264, 1 N.R.C. 347, 371-72 (1975). "The adjudicatory record and Board decision (and, of course, any Commission appellate decisions) become, in effect, part of the FEIS." CLI-01-04, 53 N.R.C. at 53, citing Louisiana Energy Services (Claiborne Enrichment Center), CLI-98-3, 47 N.R.C. 77, 89 (1998). See also Allied-General Nuclear Services (Barnwell Nuclear Fuel Plant Separations Facility), ALAB-296, 2 N.R.C. 671, 680 (1975) (where a licensing board arrives at a conclusions different from those in an FEIS, "the FEIS is simply deemed amended *pro tanto*").

This practice has been approved by several federal courts of appeal. Philadelphia Electric Co. (Limerick Generating Station, Units 1 and 2), ALAB-819, 22 N.R.C. 681, 706-07 (1985), citing Citizens for Safe Power v. NRC, 524 F.2d 1291, 1294 n.5 (D.C. Cir. 1975); New England Coalition on Nuclear Pollution v. NRC, 582 F.2d 87, 94 (1st Cir. 1978); Ecology Action v. AEC, 492 F.2d 998, 1001-02 (2d Cir. 1974). Such modification of the FEIS by a Licensing Board's decision does not normally require recirculation of the FEIS unless the modifications are truly substantial. Nine Mile Point, ALAB-264, 1 N.R.C. at 372; Allied-General, ALAB-296, 2 N.R.C. at 680.

significantly exceeds that of the State or the County percentage for either the minority or low income population, then EJ will be considered in greater detail." Id. at 52,048.

192. This statement in the Policy Statement is derived from the NMSS guidelines on EJ review. See NUREG-1748, Environmental Review Guidance for Licensing Actions Associated with NMSS Programs (Aug. 2003), App. C, Environmental Justice Procedures, at p. C-5. Tr. 753. The NMSS guidelines go on to state,

> If no minorities or low-income populations are identified in the potentially affected area or environmental impact area, then document the conclusion. The environmental justice review is complete.

NUREG-1748, App. C at C-5. The NRR guidelines similarly state:

> If there are no minority or low-income populations within the impact area(s) or if there are no potentially significant environmental impacts, then these results should be documented and the environmental justice review is complete.

LIC-2003, "Procedural Guidance for Preparing Environmental Assessments and Considering Environmental Issues' (Rev. 1, May 24, 2004), App. D, "Environmental Justice Guidance and Flow Chart," at D-10. Thus, in context, consideration of EJ in "greater detail" simply refers to performing further analysis when low income or minority populations are present, as opposed to simply documenting that no such populations are present.

193. The NRC Staff's environmental review complied with this guidance and with the Policy Statement. First, the NRC Staff located minority and low income populations in the area, though none were in close proximity to the ESP Site. Staff Exh. 3 (FEIS) § 2.10. Second, the NRC Staff interviewed resource agencies to determine if there were any populations that had dependencies or practices by which the identified pathways could introduce disproportionately high adverse impacts to receptors in those populations. Based on the interviews, no such dependencies or practices were identified. Finally, the NRC Staff determined that there would

be no health-related or location-dependent adverse impacts as a result of the proposed ESP. Staff Exh. 3 (FEIS) at 4-36 and 5-52.

194. The CEQ advises agencies to reduce excessive paperwork by providing "only brief discussion of other than significant issues." 40 C.F.R. § 1502.2(b). Because no disproportionately high adverse impacts were identified, the discussion in sections 4.7 and 5.7 is properly brief, consistent with CEQ guidance. This does not signify any failure by the NRC Staff to take the hard look at environmental impacts required by NEPA.

e. Consultation

195. NEPA Section 102(2)(C) also requires that an agency "consult with and obtain the comments of any Federal agency which has jurisdiction by law or special expertise with respect to any environmental impact involved." 42 U.S.C. § 4332(2)(C). Appendix B to the FEIS demonstrates that the NRC contacted over 60 Federal, State, regional, Tribal, local and other agencies and organizations. Appendix F of the FEIS reflects the consultations with the key agencies and their views. Ms. Patterson and Mr. Cudworth provide an expert opinion that the Staff complied with Section 102(2)(C). Dom. Exh. 10 (Dom. Env. Test.) at 12-13.

3. Compliance with 102(2)(E)

196. Finally, Section 102(2)(E) of NEPA requires a federal agency to "study, develop, and describe appropriate alternatives to the recommended courses of action in any proposal which involves unresolved conflicts concerning alternative uses of available resources." 42 U.S.C. § 4332(2)(E). As the Commission has pointed out, "the 'reasonable alternatives' issue does not apply with full force to ESP ... cases" since "the proceeding is focused on the appropriate *site*, not the actual construction of a reactor." CLI-05-17, 62 N.R.C. at 48 (emphasis in original).

Accordingly, the Board must "merely weigh and compare alternative sites, not other types of alternatives (such as alternative energy sources)." Id. (footnote omitted).

197. Consistent with NEPA Section 102(2)(E), the NRC studied, developed, and described alternatives to the ESP Site, alternatives to the cooling system, and the no action alternative. Staff Exh. 3 (FEIS), Ch. 8 and 9. Dominion's expert witnesses Patterson and Cudworth testified that the NRC Staff considered a reasonable range of alternatives and thus met its obligations pursuant to Section 102(2)(E) of NEPA. Dom. Exh. 10 (Dom. Env. Test.) at 13. As previously stated, these witnesses are well-qualified experts whose opinion is entitled to substantial weight.

198. While the Board is mindful that we are conducting a sufficiency review, and therefore should not substitute our judgment for that of the NRC Staff, the Board did probe the logic underlying the NRC Staff's consideration of alternatives. Our questioning focused on two issues: (1) whether the NRC Staff considered a reasonable range of alternative sites, and (2) whether the NRC Staff should have considered modifications of the existing units as an alternative for mitigating consumptive water use from the new units. As discussed below, the Board satisfied itself that the NRC Staff has considered appropriate alternatives.

a. Alternative Sites

199. As described in Section 9.3.1 of Dominion's Environmental Report, Dominion applied the candidate site criteria in Section 9.3 of NUREG-1555, the ESRP, to screen for candidate sites in the Region of Interest ("ROI"). Dom. Exh. 11 at 3-9-2. This screening process led to the identification of two existing nuclear sites (North Anna and Surry) owned by affiliates of Dominion, and two DOE sites (Portsmouth and Savannah River) as the candidate sites for further evaluation. Id. at 3-9-6.

200. The NRC Staff testified that, following the approach described in the Environmental Standard Review Plan, the NRC Staff reviewed the process used by Dominion to determine whether Dominion had used a reasonable process to identify candidate sites, to identify the proposed site and the alternatives, and then to compare those sites. Tr. 572 (Kugler). The NRC Staff determined that the process that Dominion used to identify the candidate sites was reasonable, and that the slate of sites was reasonable. Id.

201. The Board inquired why nuclear power plant sites owned by other companies were not considered as candidate sites. The NRC Staff responded that applicants typically limit their consideration to sites that they own or could reasonably be expected to control, and this approach comports with the Commission's guidance in Public Service Co. of New Hampshire (Seabrook Station, Units 1 and 2), CLI-77-8, 5 N.R.C. 503 (1977). Staff Exh. 11 at 94 (response to environmental question 119); Tr. 567 (Kugler).

202. Dominion similarly responded that the possibility of Dominion building new nuclear units at an unaffiliated utility's site is not reasonable, feasible or consistent with Dominion's business purposes, and therefore consideration of such alternative sites is not required by NEPA. Dom. Exh. 3 at 68 (response to environmental question 121). As discussed in Dominion's response to this question, Dominion defined its Region of Interest ("ROI") in a manner consistent with the shared interest of its parent, Dominion Resources, Inc. ("DRI"), to generate power for sale in a broad, competitive, deregulated market. Id., citing ER, § 9.3.2. Nuclear power plant sites owned by unaffiliated utilities would be direct competitors. Id. Further, those sites are located in present or former service territories in which such unaffiliated utilities have the greatest business interest. Id. In Dominion's estimation, there is no reasonable prospect that such utilities would allow a substantial competitor like Dominion to build a large generating unit at their sites. Id.

203. We agree that under these circumstances, consideration of sites owned by unaffiliated entities was not required. It is well established that NEPA's requirement to examine alternatives is subject to a "rule of reason." NRDC v. Morton, 458 F.2d 827, 834 (D.C. Cir. 1972). In Vermont Yankee Nuclear Power Corp. v. NRDC, 435 U.S. 519 (1978), the Supreme Court explained that alternatives are not self-defining and must be bounded by some notion of feasibility. 435 U.S. at 551. An EIS cannot be found wanting simply because the agency failed to include every alternative device and thought conceivable to the mind of man. Id. at 551. Thus, only reasonable alternatives – alternatives that are ascertainable and reasonably within reach – need be examined. City of Angoon v. Hodel, 803 F.2d 1016, 1022 (9th Cir. 1986), cert. denied, 484 U.S. 870 (1987); Druid Hills Civic Ass'n v. Fed. Highway Admin., 772 F.2d. 700, 712 (11th Cir. 1985), cert. denied, 488 U.S. 819 (1988). Indeed, as the 7th Circuit has recently held, NEPA does not require consideration of alternatives that an ESP applicant is in no position to implement. Envtl. Law & Policy Ctr., 470 F.3d at 684.

204. In addition, as discussed in Dominion's response, Dominion shares a business interest with its parent, DRI, to leverage its existing nuclear facilities in order to maximize the competitiveness of its generating costs and rates. Dom. Exh. 3 at 68-69 (response to environmental question 121). Building a new unit at an unaffiliated utility's site would not achieve this objective. Id. at 69. Instead, some of the benefits of adding new units at an existing site would flow to the unaffiliated utility (such as lease payments, or reduced costs from shared services). Id. Dominion stated that providing a benefit to a competitor is inconsistent with Dominion's purposes and goals. Id.

205. For this reason too, the Board agrees that consideration of alternative sites owned by unaffiliated entities is not required. Where the reviewing agency is considering a private

applicant's proposal rather than a government project, it is the private applicant's goals that shape the scope of alternatives to be considered.

> The scope of alternatives considered by the sponsoring Federal agency, where the Federal government acts as a proprietor, is wide ranging and comprehensive. Where the Federal government acts, not as proprietor, but to approve and support a project being sponsored by a local government or private applicant, the Federal agency is necessarily more limited. In the latter instance, the Federal government's consideration of alternatives may accord substantial weight to the preferences of the applicant and/or sponsor in the siting and design of the project.

Citizens Against Burlington, Inc. v. Busey, 938 F.2d 190, 197 (D.C. Cir.), cert. denied, 502 U.S. 994 (1991); City of Grapevine v. DOT, 17 F.3d 1502, 1506 (D.C. Cir.), cert. denied, 513 U.S. 1043 (1994); Envtl. Law & Policy Ctr., 470 F.3d at 683-84. See also Hydro Resources, Inc. (P.O. Box 15910, Rio Rancho, NM 87174), CLI-01-4, 53 N.R.C. 31, 55 (2001). Therefore, it is appropriate under NEPA to consider Dominion's objectives in determining what alternatives are reasonable, and to exclude consideration of alternative sites owned by unaffiliated utilities as inconsistent with Dominion's objectives.

206. The Board also inquired whether consideration should be given to non-nuclear power plant sites owned by Dominion's affiliates. Tr. 579-80. The NRC Staff testified that identification of all possible alternatives was not required (Tr. 580), that it had determined that Dominion had identified a reasonable slate of candidate sites (Tr. 571, 573-74, 580, 582); and that the alternative sites identified adequately covered the spectrum. Tr. 580 (Kugler); Staff Exh. 10 at 96 (response to environmental question 121). As the NRC Staff testified, the ESRP contemplates a slate of about 3 to 5 sites. Tr. 571 (Kugler).

207. Dominion's Supplement to the Record on Alternative Sites, which we authorized Dominion to submit (Tr. 791, 799-800), provided further explanation regarding the selection of candidate sites that we find convincing. As discussed in Section 9.3.3.4.1 of the ER, Dominion's

identification of candidate sites focused on existing nuclear sites because of the obvious benefits offered by locating a new nuclear power plant at an existing nuclear site rather than a non-nuclear site. Declaration of Marvin L. Smith (May 7, 2007), ¶ 3, citing ER at 3-9-4. The benefits included (1) the greater knowledge of environmental conditions at existing nuclear sites; (2) the ability to avoid constructing additional transmission corridors; (3) the sufficiency of the size of existing nuclear sites; and (4) the substantial advantages of nuclear infrastructure present at existing nuclear sites. Id., citing ER at 3-9-5. These criteria are extremely important to the viability of developing new nuclear units and therefore necessary to meet Dominion's needs and objectives. Id. Thus, Dominion applied reasonable criteria to develop a reasonable set of candidate sites for further study. Id.

208. The application of these criteria led to the identification of three nuclear sites owned by affiliates of Dominion (North Anna, Surry, and Millstone), as well as two DOE sites (Portsmouth, Savannah River). Id., ¶ 4. As Dominion explained, the DOE sites shared many of same advantages as the nuclear power plant sites. The DOE sites were sufficiently large, had been subject to previous nuclear safety and environmental reviews, and possessed desired infrastructure. Id.

209. Dominion's objective was to develop a list of candidate sites that represented realistic options reasonably available to Dominion. Id., ¶ 5. Indeed, Dominion states that the study that Dominion performed under a Cooperative Agreement with the U.S. Department of Energy (ER, Section 9.3, Reference 2) was specifically intended to enable all of the sites to be considered suitable for the development of new nuclear generation. Thus, the candidate sites were not selected with any intent to bias the results toward North Anna. Id.

210. The focus on existing nuclear sites reflected Dominion's knowledge that non-nuclear generating stations generally are not reasonable alternatives for siting new nuclear units. Id., ¶ 6. Dominion explained that there are a number of factors why such sites are generally not reasonable alternatives. Id.

211. First, non-nuclear power plants owned by Dominion typically lack the land needed to meet the exclusion area requirements for a nuclear power plant. Gas-fired plants are usually located on small sites. While coal-fired plants may be on larger sites, there is usually limited developable acreage because the land is used for either storage of coal or disposal of ash. Thus, developing new nuclear units at an existing non-nuclear site would typically involve developing an adjacent, greenfield property. As discussed in Section 9.3.3.3 of the Environmental Report, Dominion performed a generic analysis demonstrating that a greenfield property would not be a reasonable candidate site compared to existing nuclear sites. Id., ¶ 7.

212. Second, non-nuclear power plants typically do not have excess transmission capacity beyond that required for the operating units at those sites (as compared to Dominion's nuclear sites that were originally intended for additional units). Id., ¶ 8.

213. Third, non-nuclear power plants are often sited in locations that are more urban than is appropriate for a nuclear unit. Non-nuclear generating units are not subject to the same accident considerations and population density restrictions and therefore can be located in urban areas closer to load centers. Id., ¶ 9.

214. Beyond these considerations, Dominion stated that the likelihood that a non-nuclear site would meet all the NRC's siting criteria when these criteria were not part of the original site selection is unlikely. Id., ¶ 10.

215. To demonstrate the reasonableness of this judgment, Dominion examined the characteristics of the non-nuclear power plant sites owned by its affiliates. This examination revealed that there is only one site that would be big enough to provide an appropriate exclusion area. This site is in a mountainous location, and an initial evaluation indicates that the site would not have sufficient available water resources to support even one nuclear unit employing a reduced water consumption wet/dry cooling system as proposed for the third unit at the ESP Site. Id., ¶ 11.

216. Based on this explanation, the Board finds that the non-nuclear generating stations owned by Dominion's affiliates are not reasonable candidate sites and are not reasonable alternatives to the proposed ESP Site. Accordingly, there was no need for the FEIS to discuss such sites. To the extent that an explanation regarding why these sites were not reasonable alternatives might have been informative, the Board's findings on this matter amend the FEIS *pro tanto*.

b. Alternative Cooling Systems

217. Prior to the hearing, the Board asked whether the possibility of additional equipment or operating procedures at existing Units 1 and 2 had been considered as an alternative for mitigating the incremental adverse impacts of proposed Units 3 and 4. Both Dominion and the NRC Staff responded that this was not a reasonable alternative. Staff Exh. 10 at 86 (response to environmental question 112A); Dom. Exh. 3 at 62 (response to environmental question 112A). See also Dominion's Memorandum Responding to the Legal Questions in the Licensing Board's February 7, 2007 Order (Mar. 1, 2007) at 17 ("As a factual matter, Dominion has not identified any modifications to the design or operation of the existing units that would constitute effective or reasonable means of mitigating the consumptive use of water by new units.").

218. At the outset, it must be recognized that installing wet cooling towers on the existing units would not mitigate consumptive use of water. The use of wet cooling towers consumes more water than once-through cooling currently used for Units 1 and 2. See Tr. 116-17, 125 (Vail).

219. The water consumption of the existing units could be reduced by installing dry cooling, but this is not a reasonable alternative. NAPS Units 1 and 2 were designed and built with once-through cooling water systems. Tr. 189 (Waddill). Nuclear power plants designed with once-through cooling water systems have different condenser and turbine designs, predicated on different flows and specific temperatures, than plants designed to use cooling towers. Tr. 189-90 (Waddill). As a result, NAPS Units 1 and 2 cannot be reasonably modified to use cooling towers without rebuilding large portions of those units. Tr. 189-90 (Waddill). The addition of dry cooling towers to Units 1 and 2 would also reduce the generating capacity of the existing units. Staff Exh. 10 at 86 (response to environmental question 112A).

220. Because rebuilding NAPS Units 1 and 2 to use dry cooling towers would be costly and involve rebuilding large portions of those Units, it is not a reasonable alternative mitigation measure for any identified hydrologic impacts of the cooling method for proposed Units 3 and 4. Tr. 188-90 (Waddill); Dom. Exh. 3 at 30, 62 (response to environmental questions 45 and 112A). If it were desirable to reduce water consumption further with dry cooling, it would obviously be simpler to install such dry cooling on the new units when they are built, rather than taking the existing units out of service and extensively redesigning and modifying their cooling system. Because the same effect can always be accomplished in the design of the new units, a much more complex and costly modification of the existing units to install dry cooling can never be a reasonable alternative.

221. To reduce water consumption, other than through the redesign and rebuilding of the Units to add dry cooling towers, Units 1 and 2 would have to be de-rated, i.e., reducing the generating capacity of those units. Staff Exh. 10 at 86 (response to environmental question 112A); Dom. Exh. 3 at 30, 62 (response to environmental questions 45 and 112A); Tr. 124-25 (Vail), 191 (Waddill). Reducing the generating capacity of Units 1 and 2 is not considered a reasonable alternative mitigation measure where the purpose of the proposed action is increasing generating capacity. Staff Exh. 10 at 86 (response to environmental question 112A); Dom. Exh. 3 at 62 (response to environmental question 112A). Derating would result in lost generation and the need to provide power from other sources with associated environmental impacts. Dom. Exh. 3 at 62 (response to environmental question 112A).

222. Accordingly, based on the testimony and evidence received, the Board is satisfied that Dominion and the NRC Staff have properly considered a reasonable range of alternatives.

4. Compliance with Part 51

223. The requirements of Subpart A to 10 C.F.R. Part 51 also have been met. As Dominion's Environmental Testimony showed, Dominion prepared its ER in accordance with 10 C.F.R. § 52.17(a)(2) and 10 C.F.R. Part 51. Dom. Exh. 10 (Dom. Env. Test.) at 4. Specifically, as required by 10 C.F.R. § 52.17(a)(2), the ER complied with the requirements of 10 C.F.R. § 51.45. Dom. Exh. 10 (Dom. Env. Test.) at 4-7.

224. In accordance with 10 C.F.R. § 51.45(b), Section 1.1 of the ER provided a description of the proposed action and a statement of its purposes, and Chapter 2 of the ER provided a description of the affected environment. Id. at 4. In accordance with 10 C.F.R. § 51.45(b)(1), the impacts of the proposed action were described. Id. Chapter 4 of the ER assesses the impact of construction, Chapter 5 assesses the impact of operations, and Chapter 7 assesses the impacts

of postulated accidents. Id. This evaluation considered not only information that supports the proposed action, but also any adverse information, as required by 10 C.F.R. § 51.45(e). Id. at 5. In accordance with 10 C.F.R. § 51.50, Section 5.7 of the ER discusses the impacts from the uranium fuel cycle as 10 C.F.R. § 51.51 requires, and Section 3.8 discusses the impacts from the transportation of fuel and waste as 10 C.F.R. § 51.52 requires. Id. at 7.

225. In accordance with 10 C.F.R. § 51.45(b)(2), Section 10.1 of the ER addresses adverse environmental effects that cannot be avoided if the proposal is implemented. Id. In accordance with 10 C.F.R. § 51.45(b)(3), Chapter 9 of the ER discusses the alternatives considered. Id. These include alternate sites, alternative heat dissipation systems, and alternative circulating water systems. Id. Chapter 9 of the ER also discusses the no-action alternative (in the context of an ESP). Id. In addition, the ER sections that discuss the impacts of construction and operation consider appropriate mitigation measures. Id.

226. Section 10.3 of the ER addresses the requirements of 10 C.F.R. § 51.45(b)(4) by discussing the local short-term uses and long-term productivity of the human environment. Id. Section 10.2 of the ER addresses the requirements of 10 C.F.R. § 51.45(b)(5) by discussing irreversible and irretrievable resources committed. Id. As 10 C.F.R. § 52.17(a)(2)and 10 C.F.R. § 51.45(d) require, Section 1.2 of the ER lists the Federal, State and local permits, approvals and other entitlements which must be obtained in connection with the construction and operation of new units. Id. at 6-7.

227. Similarly, as Dominion's Environmental Testimony explains, the NRC Staff's preparation of the FEIS complied with Part 51. Id. at 13-14. In particular, the process employed by the NRC Staff satisfied all the requirements in 10 C.F.R. Part 51, including providing the required notices, conducting scoping, preparing a draft EIS and soliciting agency and public comments, and

resolving those comments. Id. at 8-11. In addition, the FEIS addresses the topics required by the applicable provisions of Part 51. Id. at 13-14.

5. Conclusion on NEPA Baseline Issue 1

228. Based on the foregoing, the Board finds that the requirements of Section 102(2)(A), (C), and (E) of NEPA and Subpart A of 10 C.F.R. Part 51 have been complied with in the proceeding.

B. NEPA Baseline Issue 2

229. With regard to NEPA Baseline Issue 2, the Board must independently consider the final balance among the conflicting factors contained in the record of the proceeding and must determine the appropriate action to be taken.

230. Dominion's witnesses testified that, based on the ER and FEIS, the balance among conflicting factors at this point in time supports issuing the ESP. Dom. Exh. 10 (Dom. Env. Test.) at 14. As Dominion's witnesses pointed out, a final cost-benefit analysis cannot be performed until the COL application stage, at which time the NRC will review the benefits of constructing a new reactor. Id. This testimony is consistent with the Commission's view that, because at the ESP stage "the environmental report will lack . . . an assessment [of the benefits of the ESP], neither the NRC Staff nor the Licensing Boards can conduct the 'weighing' in its EIS ordinarily required under NEPA." CLI-05-17, 62 N.R.C. at 47 (footnote omitted). Rather, according to the Commission, the cost-benefit analysis is "postpone[d] ... until the next (combined operating license) phase of licensing." Id. (footnote omitted). At that time, "the NRC Staff and ESP applicants will have much more cost-benefit information to provide reviewing licensing boards." Id.[37] Accordingly, the ESP and the FEIS demonstrate that the NRC Staff has

[37] See also Grand Gulf, CLI-07-14, slip op. at 3-4, stating that weighing of short term damage against long term benefits of the project cannot be assessed until the COL stage, and deferral of this issue is consistent with NEPA.

adequately considered the balance among conflicting factors to the extent required at the ESP stage.

231. Based on the foregoing, after independently considering the balance among the conflicting factors contained in the record of the proceeding and to the extent required in this proceeding, the Board finds that issuance of the ESP is the appropriate action to be taken.

C. NEPA Baseline Issue 3

232. With respect to NEPA Baseline Issue 3, the Board must determine, after considering reasonable alternatives, whether the ESP should be issued, denied, or appropriately conditioned to protect environmental values.

233. The NRC Staff analyzed alternative sites to the North Anna Power Station (FEIS Chapters 8 and 9) and concluded that no other site was obviously superior. Staff Exh. 3 (FEIS) § 9.3; Tr. 585 (Kugler). The NRC Staff also analyzed the no-action alternative, finding the environmental impacts of the proposed action and no action to be similar. Staff Exh. 3 (FEIS) § 8.1. In addition, the NRC Staff analyzed alternatives to Dominion's proposed combination wet and dry cooling water system, but found Dominion's system to be preferable. Staff Exh. 3 (FEIS) § 8.2. Finally, the NRC Staff has proposed four environmental conditions for the ESP. Staff Exh. 3 (FEIS), Table J-4. As Mr. Smith, Ms. Patterson and Mr. Cudworth testify, imposition of those conditions and the FEIS analysis of alternatives support issuing the ESP for the site in question. Dom. Exh. 10 (Dom. Env. Test.) at 15.

234. The Board has carefully reviewed the analysis of alternatives, as discussed in findings 196 to 222 supra. The Board finds that the NRC Staff has considered a reasonable range of alternatives. Based on the foregoing, the Board finds, after considering reasonable alternatives, that the ESP should be issued subject to the conditions proposed by the NRC Staff in its SER.

D. General NEPA Finding

235. For these reasons, Dominion and the NRC Staff have satisfied each of the three NEPA Baseline Issues. Furthermore, as the above discussion of each Baseline Issue demonstrates, the NRC Staff has indeed taken a "hard look" at the potential environmental impacts of granting the ESP, as required by NEPA. The NRC Staff conducted a detailed review of the ER, issued numerous RAIs, satisfied procedural requirements regarding outside consultations, solicited comments, and prepared an FEIS that complies with all requirements set forth in Subpart A of 10 C.F.R. Part 51. Accordingly, the record is sufficient to satisfy the general NEPA Issue, because it demonstrates the adequacy of Staff's NEPA review.

V. PROPOSED CONCLUSIONS OF LAW

236. Based on the foregoing, the Board concludes as follows:

237. With respect to safety issues, the Board has determined that the application and the record of this proceeding, as supplemented by the information provided to the Board during the course of its review, contain sufficient information, and that the review of the application by the NRC Staff has been adequate to support findings by the Director of New Reactors that (1) the issuance of the ESP 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 characteristics that fall within parameters for the site, can be constructed and operated without undue risk to the health and safety of the public.

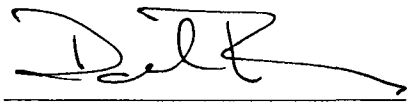
238. With respect to environmental issues, the Board has determined that the review conducted by the NRC Staff pursuant to NEPA and the Commission's implementing regulations in 10 C.F.R. Part 51 has been adequate. In addition, the Board finds that (1) the requirements of Sections 102(2)(A), (C), and (E) of NEPA and Subpart A of 10 C.F.R. Part 51 have been

complied with in this proceeding; (2) having conducted its own independent balancing of the conflicting environmental and other factors, but excluding examination of the costs and benefits of the proposed facility, the overall balance supports issuance of the license; and (3) after considering reasonable alternatives, protection of the environment does not require denial or conditioning of the license except to the extent proposed by the NRC Staff in the FSER and the FEIS. Therefore, the Board concludes that these factors support issuance of the ESP.

239. For the foregoing reasons, it is this __ day of ____, 2007, ORDERED, that the Director of New Reactors is authorized to issue Dominion Nuclear North Anna, LLC, an early site permit for the ESP Site for a duration of twenty (20) years, consistent with the Atomic Energy Act of 1954, Commission regulations, and this Initial Decision.

240. Pursuant to 10 C.F.R. § 2.1210 of the Commission's Rules of Practice, this initial decision will constitute the final decision of the Commission forty (40) days from the date of its issuance, unless a petition for review is filed in accordance with 10 C.F.R. §§ 2.341, 2.1212, or the Commission directs otherwise. This initial decision shall not become effective until the Commission actions specified in Section 2.340(f)(2) have taken place.

Respectfully submitted,



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Dated: May 11, 2007

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
	)	
(Early Site Permit for North Anna ESP Site)	)	ASLBP No. 04-822-02-ESP

CERTIFICATE OF SERVICE

I hereby certify that copies of Dominion's Proposed Findings of Fact and Conclusions of Law, dated May 11, 2007, were served on the persons listed below by deposit in the U.S. mail, first class, postage prepaid, and where indicated by an asterisk electronic mail, this 11th day of May, 2007. A copy of this pleading was also provided to Judge Elleman by overnight mail this same date.

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