Dominion Nuclear North Anna, LLC
5000 Dominion Boulevard, Glen Allen, VA 23060

Dominion®

August 2, 2004

U. S. Nuclear Regulatory Commission
Attention: Document Control Desk
Washington, D.C. 20555

Serial No. 04-318
ESP/JDH
Docket No. 52-008

DOMINION NUCLEAR NORTH ANNA, LLC
NORTH ANNA EARLY SITE PERMIT APPLICATION
RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION NO. 4

In its May 12, 2004 letter titled "Request for Additional Information Letter No. 4," the NRC requested additional information regarding certain aspects of Dominion Nuclear North Anna, LLC's (Dominion) Early Site Permit application. This letter contains our responses to the following requests for additional information (RAIs):

2.2.2-1, 2.2.2-2, 2.2.2-3, 2.3.1-2, 2.3.1-3, 2.3.1-4, 2.3.1-5, 2.3.2-1, 2.3.2-2, 2.4.1-1, 2.4.1-2, 2.4.1-3, 2.4.1-4, 2.4.2-1, 2.4.2-2, 2.4.2-3, 2.4.2-4, 2.4.3-1, 2.4.3-2, 2.4.4-1, 2.4.4-2, 2.4.7-1, 2.4.7-2, 2.4.7-3, 2.4.7-4, 2.4.7-5, 2.4.9-1, 2.4.11-1, 2.4.11-2, 2.4.12-1, 13.6-1, 17.1-1

Responses to RAIs 1.3-1 and 2.4.13-1 will be provided at a later date.

In its March 8, 2004 letter titled "Request for Additional Information No. 1," the NRC requested additional information regarding the Site Safety Analysis Report (SSAR). Dominion responded to RAI 2.3.1-1 in our May 7, 2004 letter (Serial No. 04-157A). Enclosed is a revised response to RAI 2.3.1-1 that contains corrections to our earlier response.

In its June 3, 2004 letter titled "Request for Additional Information No. 7," the NRC also requested additional information regarding the SSAR. RAI 2.3.1-6 requested a calculation of site tornado parameters using a 2-degree square box that impacts the response to RAI 2.3.1-1. Consequently, a response to RAI 2.3.1-6 is enclosed.

It is our intent to update the North Anna ESP application to reflect our responses to these and other RAIs to support issuance of the NRC staff's draft safety and environmental evaluations scheduled for later this year. Planned changes to the application are provided following the response to each RAI.

D074

If you have any questions or require additional information, please contact us.

Very truly yours,

Eugene S. Grecheck
Vice President-Nuclear Support Services

Enclosures:

1. Response to NRC RAI Letter No. 4
2. Revisions to Site Safety Analysis Report Section 2.3 and Environmental Report Section 2.7 for the responses to RAIs 2.3.1-1 (revised), 2.3.1-2, 2.3.1-3, 2.3.1-4, 2.3.1-5, 2.3.1-6, 2.3.2-1, and 2.3.2-2.
3. April 16, 2004 Letter to Marvin Smith, Dominion, from S.G. Riley III, Commander, U.S. Navy, Head, Airspace and Air Traffic Control Programs, Office of the Chief of Naval Operations, 2000 Navy Pentagon, Washington, D.C. 20350-2000. (Letter Reference - 5720, Ser N785F5/4U790281). Referenced in the response to RAI 2.2.2-2.
4. One CD-ROM containing HEC-1 input files in response to RAI 2.4.3-2. The CD-ROM is labeled, "North Anna Early Site Permit Application, Docket No. 52-008, Serial No. 04-318, Response to RAI Letter No. 4, HEC-1 Input Files in Response to RAI 2.4.3-2," and contains the following files:

001	79REV1.IH1; 2KB; publicly available
002	94REV1.IH1; 2KB; publicly available
003	95REV1.IH1; 2KB; publicly available
004	PMPREV1.IH1; 2KB; publicly available

Commitments made in this letter:

1. Revise North Anna ESP application to reflect RAI responses.

cc: (with enclosures 1,2 and 3)

U. S. Nuclear Regulatory Commission, Region II
Sam Nunn Atlanta Federal Center
61 Forsyth Street, SW
Suite 23T85
Atlanta, Georgia 30303

Mr. Jack Cushing
U. S. Nuclear Regulatory Commission
Washington, D.C. 20555

Mr. Michael Scott
U. S. Nuclear Regulatory Commission
Washington, D.C. 20555

Mr. M. T. Widmann
NRC Senior Resident Inspector
North Anna Power Station

Ms. Ellie Irons
Virginia Department of Environmental Quality
Office of Environmental Impact Review
P.O. Box 10009
Richmond, VA 23240

COMMONWEALTH OF VIRGINIA

COUNTY OF HENRICO

The foregoing document was acknowledged before me, in and for the County and Commonwealth aforesaid, today by Eugene S. Grecheck, who is Vice President, Nuclear Support Services, of Dominion Nuclear North Anna, LLC. He has affirmed before me that he is duly authorized to execute and file the foregoing document on behalf of Dominion Nuclear North Anna, LLC, and that the statements in the document are true to the best of his knowledge and belief.

Acknowledged before me this 2nd day of August, 2004.

My Commission expires: 3/31/08

Maggie J. McClure
Notary Public

(SEAL)

Enclosure 1

Response to NRC RAI Letter No. 4

RAI 2.2.2-1 (NRC 5/12/04 Letter)

Please provide a scoping description of the nature of the industrial development (e.g., light commercial, heavy industrial) that may occur pursuant to the Louisa County Board of Supervisors zoning ordnance allowing industrial development of approximately 620 acres near the site exclusion boundary (EAB) and indicate the approximate zoned area boundary location on a map that includes the ESP site.

Response

The scoping description for property in Louisa County that is zoned industrial is provided in Sections 86-161 to 86-163 of the Louisa County Code of Ordinances (Reference 1). These sections are provided at the end of this RAI response.

Reference 2 provides the website link to Louisa County's on-line GIS service. Figure 1 contains a printout from this website that shows the industrial property adjacent to the North Anna ESP site. Industrial property appears in brown on the map. The map obtained from the website (refer to map # 30 on the website) has been marked in Figure 1 to show the North Anna ESP site and the EAB.

References

1. The Code of Ordinances, County of Louisa, Virginia, Codified though Ordinance of July 7, 2003 (Supplement No. 13). Available on website: http://livepublish.municode.com/19/lpext.dll/Infobase24/1/f14/116a/12f7/1320?fn.

2. Available on website: www.onlinegis.net\valouisa.

Application Revision

None.

Louisa County Code of Ordinances

Sec. 86-161. Statement of intent; policy guidance.

The primary purpose of the industrial district (IND), is to establish areas where the principal use of land is for heavy commercial and industrial operations, which may create some nuisance, and which are not properly associated with, nor particularly compatible with, residential, institutional and neighborhood commercial service establishments. The specific intent of this district is to:

(1) Encourage the development of and the continued use of land designated for heavy commercial and industrial purposes; and

(2) Prohibit residential and general commercial use of the land, and to prohibit any other use which would substantially interfere with the development, continuation or expansion of heavy commercial and industrial uses in the district.

(Code 1971, § 21-67)

Sec. 86-162. Permitted uses.

In any industrial district (IND) as indicated on the zoning map, there shall be no restriction as to use, except that no lot, building or structure shall be used and no building or structure shall be erected which is intended or designed to be used, in whole or in part, for any use which is in conflict with any ordinance of the county now existing or hereafter enacted; nor for any of the following listed purposes, without first obtaining a conditional use permit and approval of the health department:

(1) Abattoir or slaughterhouse.

(2) Acetylene gas manufacture on a commercial scale.

(3) Asphalt roofing, tar roofing or waterproofing manufacture.

(4) Bleaching powder, ammonia or chlorine manufacture.

(5) Celluloid or pyroxline manufacture or processing; the manufacture of explosives or highly inflammable cellulose products.

(6) Coal tar manufacture or tar distillation, except as byproducts or incidental to the manufacture

(7) Creosote manufacture or creosote treatment.

(8) Distillation of wood or bones.

(9) Fat rendering, except in the preparation of lard; the preparation or refining of tallow or grease; the manufacturing of candles from animal fats.

(10) Fertilizer manufacture from organic material, or the compounding of such fertilizers on a commercial scale.

Louisa County Code of Ordinances (cont'd)

(11) Fireworks or explosives manufacture, nitrating process, the loading of explosives or their storage in bulk.

(12) Fish smoking or curing or processes involving recovery of fish or animal offal.

(13) Gas storage in quantity exceeding 500,000 cubic feet within 100 feet of any party lot line; or in quantity exceeding 200 cubic feet, if the pressure is greater than 100 pounds per square inch within 50 feet of any party lot line.

(14) Glue or size manufacture.

(15) Horn processing.

(16) Lime, gypsum, plaster, or plaster of Paris manufacture.

(17) Match manufacturing.

(18) Petroleum refining.

(19) Potash manufacture.

(20) Residential, except dwellings for watchmen and caretakers employed on premises.

(21) Sanitary landfills, sludge storage, human waste storage or treatment facilities, hazardous waste or substance storage.

(22) Smelting of copper, tin, zinc or aluminum ores.

(23) Soda, soda ash, caustic soda or washing compound manufacture.

(24) Starch, glucose and dextrine manufacture.

(25) Sulphurous, sulphuric, nitric or hydrochloric or other corrosive or offensive acid manufacture, or their use or storage, except on a limited scale (by conditional use permit) as accessory to a permitted industry.

(26) Turpentine, varnish or shellac manufacture.

(27) Any other use or purpose which will create or is likely to create conditions of smoke, fumes, noise, odors, dust, or water pollution, determintal to the health, safety or general welfare of the community.

(28) Auto graveyards and junkyards may be permitted in the industrial district (IND) upon issuance of a conditional use permit. The requirement for issuance of such permit shall be that the operation or use of such auto graveyards and junkyards shall be completely screened on all open sides by a masonry wall, a uniformly painted solid board fence, and evergreen hedge, or such other fencing or screening as the planning commission shall recommend, all of which shall be properly maintained.

Auto graveyards and junkyards in existence at the time of the adoption of this chapter are to be considering nonconforming uses. They shall be allowed up to 18 months after adoption of this chapter in which to discontinue and remove, or completely screen, on all open sides, the operation or use, by a masonry wall, a uniformly painted solid board fence, an evergreen hedge, or such other fencing or screening as the planning commission shall recommend, all of which shall be properly maintained.

(29) Mining, as that term is defined in Code of Virginia, § 45.1-271; provided, however, the governing body may, in any instance where a bond is required under Code of Virginia, title 45.1, require that the mining operator increase the statutory bond so required at any given time and from time to time, or require an additional bond, with corporate surety licensed to do business in the state, payable to the governing body in an amount deemed reasonable to the governing body to assure performance of all the requirements of Code of Virginia, title 45.1 applicable to such mining and of the required plan of operations, as the same may be approved and directed by the representatives of the commonwealth vested with such powers; but in no event shall the total of the bond, or bonds, in effect exceed, by reason of the governing body's action, an amount of more than $10,000.00 per acre, based on the acreage subject to bonding under Code of Virginia, title 45.1. In lieu of an increase or additional bond, and upon application of the mining operator, the governing body may accept a written guarantee of performance of all conditions applicable to such bond in a form acceptable to the governing body.

(30) Telecommunication structures, towers and antennas.

(Code 1971, § 21-68; Res. Of 1-23-91 (2); Res. Of 11-1-99(.326))

Editor's Note: The effective date of the ordinance was July 1, 1969, at 12:01 a.m.

Sec. 86-163. Requirements for permitted uses.

Before a building permit shall be issued or construction commenced on any permitted use in the industrial district (IND), or a zoning permit issued for a new use, the plans, drawn in sufficient detail to show the operations and processes, shall be submitted to the zoning administrator for study. The administrator shall refer these plans to the planning commission for its recommendation. Modification of the plans may be required before a permit is issued.

(Code 1971, § 21-70)

Secs. 86-164—86-175. Reserved.

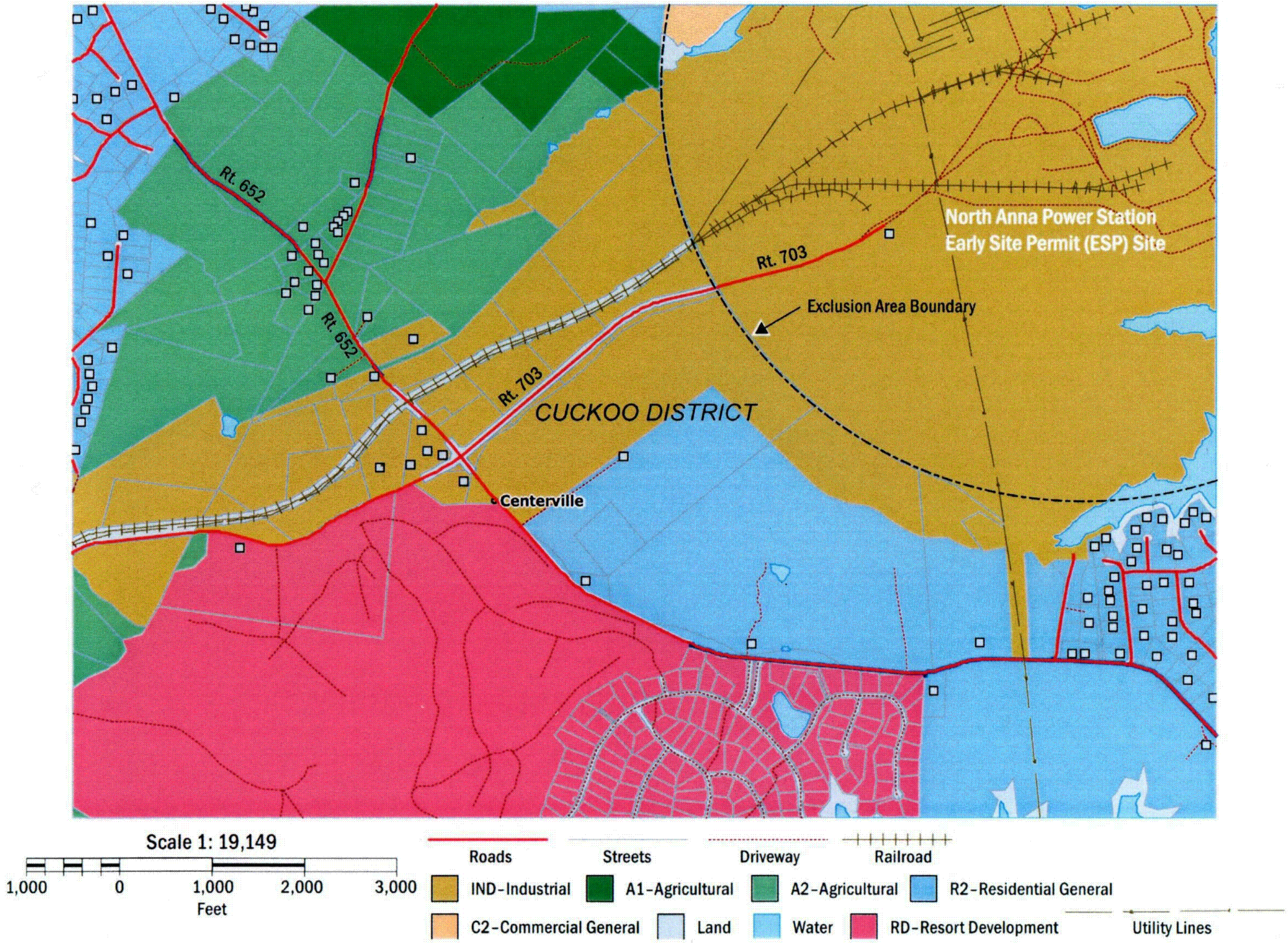


Figure 1. Industrial Property Adjacent to the North Anna ESP Site.

RAI 2.2.2-2 (NRC 5/12/04 Letter)

Please provide separate estimates of the annual flight frequency for each of the three military training routes (IR714, IR760, and VR1754) identified in SSAR Section 2.2.2.6.2. The estimates should represent maximum flight frequencies projected over the proposed term of the ESP. Please indicate the source of the estimated flight frequency data.

Response

In Reference 1, the U.S. Navy provided the following annual flight frequency information to Dominion:

Route	Total Aircraft for 2003
IR714	194
IR760	288
VR1754	375
Total	857

For 2004, the total projected usage of these military training routes is 1130, per Reference 1. The U.S. Navy did not provide projections beyond 2004.

A copy of Reference 1 is provided as an enclosure to this letter.

Reference

1. April 16, 2004 Letter to Marvin Smith, Dominion, from S.G. Riley III, Commander, U.S. Navy, Head, Airspace and Air Traffic Control Programs, Office of the Chief of Naval Operations, 2000 Navy Pentagon, Washington, D.C. 20350-2000. (Letter Reference - 5720, Ser N785F5/4U790281).

Application Revision

None.

RAI 2.2.2-3 (NRC 5/12/04 Letter)

Please state whether there are any types of pipelines carrying potential hazardous materials (e.g., propane, chlorine) within five miles of the ESP site. If any hazardous material pipelines are identified, please provide their location on a map (to be withheld from public disclosure per 10CFR2.390(d)) that includes the ESP site.

Response

There are no pipelines carrying potential hazardous materials within five miles of the ESP site.

Application Revision

SSAR Section 2.2.3.1.2 will be revised to read as follows:

2.2.3.1.2 **Pipelines**

No natural gas pipeline or mining facilities are located within 10 miles of the ESP site. There are no pipelines carrying potential hazardous materials within 5 miles of the ESP site. Therefore, the potential for hazards from these sources that could adversely affect safe operation of the plant is minimal.

RAI 2.3.1-1 (NRC 3/8/04 Letter)

SSAR Section 2.3.1, Regional Climatology

SSAR Section 2.3.1 provides climatological information. Sections 2.3.1 of Regulatory Guide 1.70 and Review Standard RS-002 describe methods and approaches acceptable to the staff for addressing the regulations. Both these documents state that all the meteorological data used for design basis considerations should be documented and substantiated. Consistent with the guidance in these documents, please provide the site characteristic values listed below. The bases or sources for these site characteristic values should also be provided. These site characteristics represent typical design parameter information for a range of reactor designs.

a) 3-second gust wind speed that represents a 100-year return period.

b) Maximum ambient dry bulb temperature (along with the concurrent wet bulb temperatures) that:
   i) will be exceeded no more than 5% of the time seasonally or 2% of the time annually.
   ii) will be exceeded no more than 1% of the time seasonally or 0.4% of the time annually.
   iii) represents a 100-year return period.

c) Minimum ambient dry bulb temperature that:
   i) will be exceeded no more than 5% of the time seasonally or 1% of the time annually.
   ii) will be exceeded no more than 1% of the time seasonally or 0.4% of the time annually.
   iii) represents a 100-year return period.

d) Maximum ambient wet bulb temperature that:
   i) will be exceeded no more than 1% of the time seasonally or 0.4% of the time annually.
   ii) represents a 100-year return period.

e) Weight of the 100-year return period snow pack and weight of the 48-hour winter Probable Maximum Precipitation, and the resulting maximum ground snow and ice load (water equivalent) that would be placed on the roofs of structures important to safety.

f) The ultimate heat sink (UHS) meteorological conditions resulting in the maximum evaporation and drift loss of water from the UHS and minimum cooling by the UHS.

g) The tornado maximum wind speed (translational and rotational), the radius of the maximum rotational wind speed, the maximum pressure drop, and the rate of the maximum pressure drop associated with a probability of occurrence of 10^{-7} per year.

Alternative approaches to evaluating extreme weather phenomena important to design of structures, systems, and components of a nuclear power plant or plants that might be constructed on the site may be used if appropriately justified.

Revised Response

a) The 3-second gust wind speed that represents a 100-year return period is 96 mph (10 meters above ground). The 96-mph wind speed was determined in accordance with Figure 6-1 and Table C6-3 of Reference 1.

(Note: The response to part a) is unchanged from the original response in Dominion's May 7, 2004 letter, Serial No. 04-157A.)

b) The maximum ambient dry bulb temperature (along with the concurrent wet bulb temperatures) that:

i) will be exceeded no more than 2% of the time annually is 90°F (75°F concurrent wet bulb). This temperature is based on Reference 2.

ii) will be exceeded no more than 0.4% of the time annually is 95°F (77°F concurrent wet bulb). This temperature is based on Reference 2.

iii) represents a 100-year return period is 109°F. This temperature is predicted by an extrapolation (using the least-squares, regression method) of actual temperatures from 1973 to 2002 (References 3, 4, and 5). The concurrent wet-bulb temperature is not predictable by the extrapolation. For information, considering the same timeframe and reference data, the 0% exceedance, maximum, dry-bulb temperature is 104.9°F (79°F concurrent wet bulb).

(Note: The response to part b) is unchanged from the original response in Dominion's May 7, 2004 letter, Serial No. 04-157A, with the exception that (1) the 75°F in subpart i) and the 109°F temperature in subpart iii) corrects the previous response.)

c) The minimum ambient dry bulb temperature that:

i) will be exceeded no more than 1% of the time annually is 18°F. This temperature is based on Reference 2.

ii) will be exceeded no more than 0.4% of the time annually is 14°F. This temperature is based on Reference 2.

iii) represents a 100-year return period is -19°F. This temperature is predicted by use of the same method described in the response to b) iii) for minimum dry-bulb temperatures and References 3, 4, and 5.

(Note: The response to part c) is unchanged from the original response in Dominion's May 7, 2004 letter, Serial No. 04-157A, with the exception that the -19°F temperature in subpart iii) corrects the previous response.)

d) The maximum ambient wet bulb temperature that:

i) will be exceeded no more than 0.4% of the time annually is 79°F. This temperature is based on Reference 2.

ii) represents a 100-year return period is 88°F. This temperature is predicted by use of the same method described in the response to b) iii) for maximum wet-bulb temperatures and References 3, 4, and 5. For information, the 0% exceedance, maximum, wet-bulb temperature is 84.9°F.

(Note: The response to part d) is unchanged from the original response in Dominion's May 7, 2004 letter, Serial No. 04-157A, with the exception that the 88°F temperature in subpart ii) corrects the previous response.)

e) The weight of the 100-year return period snow pack is 30.5 pounds per square foot. The snow pack weight was determined in accordance with Figure 7-1 and Table C7-3 of Reference 1.

The 48-hour winter Probable Maximum Precipitation is 20.75 inches. The amount of the 48-hour winter PMP was linearly interpolated from values shown in Figures 35 and 45 of Reference 6, for the 24-hour and 72-hour, respectively, events in December. The month of December has the highest winter PMP values.

The maximum load experienced by the roof structure, due to precipitation, is dependent on the roof design/configuration. For example, the roof load could be governed by the maximum accumulation of snow and a surcharge due to the loading from the overflow depth as runoff flows over the roof. The design capacity of the roof structure and other design features that demonstrate acceptable roofing structure performance would be described in the COL application.

(Note: The response to part e) is changed from the original response in Dominion's May 7, 2004 letter, Serial No. 04-157A. The response is clarified and is consistent with RAI 2.4.7-5 contained in this letter.)

f) The evaluation for the meteorological conditions resulting in the maximum evaporation and drift loss of water from and minimum cooling by the ultimate heat sink (UHS) is in accordance with the guidance of RG 1.27 and uses data from References 3, 4, and 5. The controlling parameters for the type of UHS selected for the ESP application (i.e., mechanical draft cooling tower over a buried water storage basin or other passive water storage facility, as required by the reactor design) are the wet-bulb temperature and coincident dry-bulb temperature.

The *meteorological conditions resulting in the maximum evaporation and drift* loss of water from the UHS are the worst 30-day average combination of controlling atmospheric parameters. The worst 30-day daily average of wet-bulb temperatures and coincident dry-bulb temperatures is 76.3°F and 79.5°F, respectively, considering the referenced data and encompassing a 25-year period from 1978 to 2003. Calculating "running, 30-day," daily averages and selecting the 30-day period with the highest daily average wet-bulb temperature, determined the worst 30-day period.

The meteorological condition resulting in minimum water cooling is the worst combination of controlling atmospheric parameters, including diurnal variations where appropriate, for the critical time periods unique to the UHS design. Conservatively, the meteorological conditions, resulting in the minimum cooling by the UHS, considered the worst 1-day and worst 5-day daily average of wet-bulb temperatures and coincident dry-bulb temperatures. The worst 1-day is the day having the highest daily average wet-bulb temperature. The worst 1-day wet-bulb temperature and coincident dry-bulb temperature are 78.9°F and 87.7°F, respectively. The worst 5-day daily average of the wet-bulb temperatures and coincident dry-bulb temperatures is 77.6°F and 80.9°F, respectively. Calculating "running, 5-day," daily averages and selecting the 5-day period with the highest daily average wet-bulb temperature determined the worst 5-day period. Both the worst 1-day and the worst 5-day temperatures were determined using the same reference data and over the same period as the worst 30-day temperatures.

(Note: The response to part f) is unchanged from the original response in Dominion's May 7, 2004 letter, Serial No. 04-157A.)

g) The parameters of a site tornado associated with a probability of occurrence of 10^{-7} per year are tabulated below.

Parameter	Site Tornado (10^{-7} per year occurrence)
Maximum wind speed, mph	260
Maximum translational wind speed, mph	52
Maximum rotational speed, mph	208
Radius of maximum rotational wind speed, feet	150
Pressure drop, psi	1.5
Rate of maximum pressure drop, psi/sec	0.76

The methods used to estimate the tornado strike probability and define the site tornado parameters in the table above are described in Reference 7. The methods used in calculating the tornado parameters followed those specified in References 7, 8, and 9. Using Reference 10 meteorological data, all reported tornado occurrences over the period of 1950 to 2003, within a "2-degree square" (i.e., an area enclosed by 2-degree longitudinal and latitudinal lines, Reference 7) centered on the ESP site, were tabulated and considered in the determination of the site tornado. A total of 235 tornados were recorded within the square over the period. The most intense were three classified F4 (93 to 116 meters per second) on the Fujita-Pearson tornado scale. The maximum wind speed at the site associated with a tornado having a probability of occurrence of 10^{-7} per year is slightly less than the upper limit of the F4 wind speed of 116 meters per second (260 miles per hour); however, the upper limit was conservatively selected.

(Note: The response to part g) is changed from the original response in Dominion's May 7, 2004 letter, Serial No. 04-157A, to reflect tornado occurrences within a 2-degree square box. See also the response to RAI 2.3.1-6 that is contained in this letter.)

References

1. *Minimum Design Loads for Buildings and Other Structures*, SEI/ASCE 7-02, Revision of ASCE 7-98, American Society of Civil Engineers (ASCE), and Structural Engineering Institute (SEI), January 2002.

2. Richmond, Virginia, 1973 – 1996, *Engineering Weather Data, Version 1.0, 2000 Interactive Edition*, developed by the Air Force Combat Climatological Center, published by the National Climatic Data Center, NOAA, December 1999.

3. Richmond, Virginia, *Solar and Meteorological Surface Observation Network, 1961-1990, Vol. 1, Eastern U.S., Version 1.0,* National Climatic Data Center and National Renewable Energy Laboratory, September 1993.

4. Richmond, Virginia, *Hourly United States Weather Observations, 1990-1995,* National Climatic Data Center, NOAA.

5. Richmond, Virginia, Hourly United States Weather Observations, 1996-2003, National Climatic Data Center, NOAA.

6. NUREG/CR-1486, Seasonal Variation of 10-Square Mile Probable Maximum Precipitation Estimates, United States East of the 105th Meridian, Hydrometeorological Report No. 53, U.S. Department of Commerce, National Oceanic and Atmospheric Administration, U.S. Nuclear Regulatory Commission, April 1980.

7. *Technical Basis for Interim Regional Tornado Criteria,* WASH-1300, U.S. Atomic Energy Commission, May 1974.

8. *Extreme Meteorological Events in Nuclear Power Plant Siting, Excluding Tropical Cyclones, A Safety Guide, 1981*: IAEA Safety Guides, Safety Series No. 50-SG-S11A, International Atomic Energy Agency, Vienna.

9. Safety Evaluation by the Office of Nuclear Reactor Regulation of Recommended Modification to the RG 1.76 Tornado Design Basis for the ALWR, U. S. Nuclear Regulatory Commission, March 1988.

10. *Storm Events for Virginia, 01/01/1950 Through 12/31/2003,* National Climatological Data Center, National Oceanic and Atmospheric Administration, Website, www4.ncdc.noaa.gov/cgi-win/wwcgi.dll?wwevent~storms, accessed June 2004.

<u>**Application Revision**</u>

See Enclosure 2 for changes to SSAR Section 2.3.1 and ER Section 2.7 that reflect the responses to RAIs 2.3.1-1 (revised), 2.3.1-2, 2.3.1-3, 2.3.1-4, 2.3.1-5, 2.3.1-6, 2.3.2-1, and 2.3.2-2 contained in this letter.

RAI 2.3.1-2 (NRC 5/12/04 Letter)

SSAR Section 2.3.1 states that a total of 7 hurricanes and 2 tropical storms passed within 100 nautical miles of the ESP site from January 1950 through June 2002. Please explain whether the tropical storm and hurricane data presented in the SSAR addresses hurricane data for the period 1950 to 1993 (for example, two hurricanes that brought record rainfall to Richmond during 1955, Connie and Diane, as well as hurricane Camille in 1969). If it does not, please address hurricanes in this period or explain why this information is not needed. Also, please include information on Hurricane Isabel in September 2003, or explain why this information is not needed. Please evaluate the impact of these data on the North Anna site characteristics.

Response

The number of hurricanes and tropical storms presented in SSAR Section 2.3.1.3.3 and ER Section 2.7.3.4 covered the period from 1993 (except for June and July of that year, noted as missing by National Climatic Data Center (NCDC) on their Storms Events web site) through December 2, 2002 (the date those data were extracted from the Storm Events data base during preparation of the ESP application).

A more comprehensive database of historical tropical cyclone tracks (i.e., extending back to 1851) is available through the National Oceanic and Atmospheric Administration's Coastal Services Center based on information compiled by the National Hurricane Center. These data were used to respond to this RAI regarding the frequency of tropical cyclone events within a 100-nautical mile radius of the North Anna ESP site.

Tropical cyclones include not only hurricanes and tropical storms, but systems classified as tropical depressions, sub-tropical depressions and extra-tropical storms, among others. All tropical cyclones within the area of consideration are included in the characterization because storm classifications are generally downgraded once landfall occurs and the system weakens, although it may still result in significant rainfall events as it travels through the site region. Entries from the NCDC publication "Storm Data" and measurements taken at the Richmond, VA National Weather Service (NWS) station and other NWS cooperative observation network stations are evaluated to give an indication of the resulting effects of these storms in the site area (i.e., precipitation totals).

The information has been queried from the database using the "Zip Code" option and the postal code for the nearby town of Mineral, VA (i.e., 23117) in order to obtain a graphical depiction of the 100-nautical mile radius and storm tracks. Any storm center coordinates located within, or any storm track that passes through, the area circumscribed by this radius is extracted from the database. In the event that a storm's classification changed as it traversed this area, the higher, more intense classification is used in determining the count for a particular type of tropical cyclone.

For the period from 1851 through 2003, a total of 55 tropical cyclone centers or storm tracks have passed within a 100-nautical mile radius of the North Anna ESP site. Storm classifications and respective frequencies of occurrence over this period of record are as follows:

- Hurricanes – 1 (Category 3), 1 (Category 2), 5 (Category 1)
- Tropical Storms – 27
- Tropical Depressions – 13
- Subtropical Depressions – 1
- Extra-Tropical Storms – 7

The track of Hurricane Connie, which occurred in 1955, falls outside the 100-nautical mile radius, being about 120 nautical miles away from the North Anna ESP site at its closest approach, and therefore is not included in the count of tropical cyclones. Nevertheless, then classified as a tropical storm, Connie was responsible for the current record 24-hour (daily) rainfall total at Richmond International Airport (i.e., 8.79 inches). The cause of this event is clarified in the discussion of precipitation extremes in the revisions to SSAR Section 2.3.1.3.4 (see Enclosure 2).

Hurricane Camille, which occurred in 1969, was a tropical depression as it passed through the 100-nautical mile radius area around the North Anna site and is included in the tropical cyclone count. This storm was responsible for a 24-hour (daily) rainfall total at the nearby Louisa cooperative observation station (i.e., 11.18 inches), a new record for the site area. This event is addressed in the revisions to SSAR Sections 2.3.1.3.3 and 2.3.1.3.4 (see Enclosure 2).

Hurricane Isabel passed through Central Virginia and the area within 100-nautical miles of the North Anna ESP site in September 2003. However, the amount of rainfall associated with it represented neither a record 24-hour (daily) rainfall total nor a record monthly rainfall total at the Richmond, Virginia first-order NWS station or at any of the other nearby cooperative observing stations that were used to characterize normal, mean, and extreme climatological conditions in the ESP site area. Consequently, Hurricane Isabel is not included in the revisions to SSAR Section 2.3.1.3.4 in Enclosure 2.

Application Revision

See Enclosure 2 for changes to SSAR Section 2.3.1 and ER Section 2.7 that reflect the responses to RAIs 2.3.1-1 (revised), 2.3.1-2, 2.3.1-3, 2.3.1-4, 2.3.1-5, 2.3.1-6, 2.3.2-1, and 2.3.2-2 contained in this letter.

RAI 2.3.1-3 (NRC 5/12/04 Letter)

SSAR Section 2.3.1 states that a total of 65 hail storms, 19 snow storms, and 10 ice storms were reported for the period between 1950 and 2002. These statistics were apparently based on information listed in the U.S. Storm Events Database on the National Climatic Data Center's web site. However, this database only includes hail data from 1955 through to the present and snow and ice events from 1993 through the present. Please identify the source of data for hail events before 1955, and the source of data for snow and ice events before 1993, or clarify the time periods for which data are available for these events.

<u>Response</u>

The time periods covered in the original SSAR and ER by the U.S. Storm Events Database on the National Climatic Data Center's (NCDC's) web site for hailstorms, snowstorms and ice storms are as stated in RAI 2.3.1-3 and were based on the discussion of the database contents from the selected page of that web site.

Rather than supplementing the counts of snowstorm and ice storm events prior to 1993 with entries from the NCDC publication "Storm Data" (which dates back to January 1959) and subsequent to 2002 with queries of the current Storm Events Database (also based on Storm Data), the frequency of occurrence of these events in the North Anna ESP site area is now characterized in the revisions to SSAR Section 2.3.1.3.5 (see Enclosure 2) using information from the Climate Atlas of the United States, published by NCDC in September 2002.

The graphical representations for these two weather elements in the Climate Atlas are based on the 1961 to 1990 period of record. The period of record covered for hailstorms in the Storm Events Database would be adequate (i.e., 1955 to present) and would otherwise not need to be supplemented for events prior to 1955. However, the frequency of occurrence for this weather element (described in the revisions to SSAR Section 2.3.1.3.5 in Enclosure 2) is now based on graphical representations from the Climate Atlas and the same 30-year period from 1961 to 1990 as snowstorms and ice storms.

Snowstorm frequency is now characterized by the annual mean number of days for events in relation to three threshold snowfall totals (i.e., greater than or equal to 1.0 inch, 5.0 and 10.0 inches). Similarly, the annual mean number of days with freezing rain in the ESP site area are identified. The frequency of occurrence of hailstorms is described on a seasonal and annual basis and with respect to the size of the hailstones encountered during such events – that is, greater than or equal to a 0.75-inch diameter (seasonal and annual) and greater than or equal to a 1.0-inch diameter (annual only).

In addition, the area around the ESP site now taken into consideration for this revised evaluation is expanded. In the original SSAR and ER, the Storm Events Database was queried for the occurrence of hailstorms, snowstorms and ice storms in Louisa County along with the "surrounding" (adjacent) counties of "Hanover, Caroline, Spotsylvania and Orange". The remainder of the "surrounding" counties (i.e., Albemarle, Fluvanna, and Goochland), as well as nearby Henrico County, is now added to this list.

Albemarle County is located immediately to the west of Louisa County but is part of Virginia Climate Zone 3 (the Western Piedmont), whereas the other counties listed above are within Virginia Climate Zone 2 (the Eastern Piedmont). However, the central to eastern portions of Albemarle County are now considered because the cooperative climatological network station in Charlottesville was used, and continues to be used, to characterize extreme temperature and precipitation events in the ESP site area.

Henrico County, although not immediately adjacent to Louisa County, is nevertheless close enough to the ESP site (to the southeast) and is taken into account because observations from the first-order National Weather Service station at Richmond have been used extensively for the climatological and meteorological-related analyses in SSAR Section 2.3 and ER Section 2.7. The inclusion of Henrico County is also relevant with respect to evaluating the frequency of occurrence of hailstorms in the ESP site area because, as NCDC cautions, these events (as reported in Storm Data) are based on point observations and are therefore related to population density in the observation area.

Entries from the Storm Events Database and/or the Storm Data publication are now used to give an indication of the magnitude and duration of these events.

Application Revision

See Enclosure 2 for changes to SSAR Section 2.3.1 and ER Section 2.7 that reflect the responses to RAIs 2.3.1-1 (revised), 2.3.1-2, 2.3.1-3, 2.3.1-4, 2.3.1-5, 2.3.1-6, 2.3.2-1, and 2.3.2-2 contained in this letter.

RAI 2.3.1-4 (NRC 5/12/04 Letter)

Please provide an estimate of lightning strike frequencies in the vicinity of the North Anna ESP site.

Response

An estimate of lightning strike frequencies in the vicinity of the North Anna ESP site is provided in ER Section 2.7.3.1. The ER information will be added to the SSAR.

Application Revision

See Enclosure 2 for changes to SSAR Section 2.3.1 and ER Section 2.7 that reflect the responses to RAIs 2.3.1-1 (revised), 2.3.1-2, 2.3.1-3, 2.3.1-4, 2.3.1-5, 2.3.1-6, 2.3.2-1, and 2.3.2-2 contained in this letter.

RAI 2.3.1-5 (NRC 5/12/04 Letter)

The extreme meteorological values for Charlottesville and Richmond presented in SSAR Section 2.3.1.3.4 and SSAR Table 2.3-5 appear to be based on data recorded through 1987. Please address extreme meteorological values for Charlottesville and Richmond from 1987 to the present, or justify why such information is not needed. Also, please address data from other nearby climatic stations in the same climate division as the North Anna ESP site, such as Louisa and Partlow, to confirm that the Charlottesville and Richmond data presented in the SSAR are representative of the regional climatology.

Response

In responding to the first part of this RAI to provide information on extreme climatological values subsequent to 1987, it was determined that the National Climatic Data Center (NCDC) had performed and made available in various products the results of its decennial update of the 30-year normals (averaging) period to cover the period of record from 1971 to 2000. As a result, it was further determined that:

- Normals for several parameters had changed based on the updated 30-year period or because of the inclusion of additional years of measurements for longer-term means,
- Previous historical extreme values for several parameters had changed subsequent to 1987, and
- Periods of record included in defining historical extremes for certain parameters in some cases spanned the station's recorded history as verified and maintained by NCDC and in other cases was confined to the latest 30-year normals period which proved to be inconsistent with some of the extremes reported previously for Richmond and Charlottesville.

In responding to the second part of the RAI to provide "data from other nearby climatic stations in the same climate division as the North Anna ESP site," five additional stations in the National Weather Service's (NWS') network of cooperative observer stations were identified within Virginia Climate Zone 2 (Eastern Piedmont), including: Partlow 3WNW, Louisa, Piedmont Research Station, Gordonsville 3S and Fredericksburg National Park.

Observations from each of these stations (except Gordonsville 3S) were noted within or considered in the preparation of SSAR Section 2.3. The reference lists for SSAR Section 2.3 already includes the climatological summaries for each of these stations.

Consequently, it was decided to update SSAR Tables 2.3-5 and 2.3-7 to present climatological extremes and normals (means) of temperature and precipitation (rainfall and snowfall), as appropriate to those tables. It likewise became necessary to revise SSAR Table 2.3-2 to indicate the approximate distance and direction of these stations relative to the ESP site (based on the coordinates of Unit 2 and the station coordinates as identified by NCDC).

The addition of normals, means, and/or extremes for these other cooperative observing stations to the tables indicated above required consideration of the issues associated with the update to the most recent 30-year normal period (except for Partlow 3WNW which was decommissioned at the end of 1976). Nevertheless, the climatological summary for Partlow 3WNW was retained because that station is the closest to the ESP site and the period of record covered by that summary is reasonably long (i.e., 20 years).

To fill any gaps in the station histories created by how some extremes were now limited only to the updated period of record, two other NCDC resources were taken into account:

- Climatography of the United States No. 81 (CLIM 81), U.S. Daily Climate Normals (1971-2000) summaries for Fredericksburg National Park and Gordonsville 3S, Virginia (Reference 1), and
- Cooperative Summaries of the Day (TD3200) for Charlottesville 2W, Fredericksburg National Park, Gordonsville 3S, Louisa, Partlow 3WNW, Piedmont Research Station, Bremo Bluff PWR and Free Union, Virginia (Reference 2).

Specific values and related information appear throughout the revisions to SSAR Section 2.3 (see Enclosure 2).

<u>References</u>

1. Climatography *of* the *United States No. 81, U.S. Daily Climate Normals (1971-2000), Version 2.0 (December),* summaries for Fredericksburg National Park and Gordonsville 3S, Virginia, National Climatic Data Center, NOAA.

2. *Cooperative* Summary *of the Day, TD3200, Period of Record through 2001 includes daily weather data from the Eastern United States, Puerto Rico, and the Virgin Islands, data released November 2002, Version 1.0 (CD-ROM),* data listings for Charlottesville 2W, Fredericksburg National Park, Gordonsville 3S, Louisa, Partlow 3WNW, Piedmont Research Station, Bremo Bluff PWR and Free Union, Virginia, National Climatic Data Center, NOAA.

<u>Application Revision</u>

See Enclosure 2 for changes to SSAR Section 2.3.1 and ER Section 2.7 that reflect the responses to RAIs 2.3.1-1 (revised), 2.3.1-2, 2.3.1-3, 2.3.1-4, 2.3.1-5, 2.3.1-6, 2.3.2-1, and 2.3.2-2 contained in this letter.

RAI 2.3.1-6 (NRC 6/3/04 Letter)

The methodology used to determine site-specific design-basis tornado parameters as discussed in the response to RAI 2.3.1-1(g) is very sensitive to changes in F class of 1 or 2 tornadoes when the total number of tornadoes is small (24). Consequently, the uncertainty in the estimate of the wind speed is large. Please calculate the site tornado parameters using a 2-degree square box and provide the staff a copy of the resulting calculation/analysis.

Response

As requested in the RAI, site tornado parameters have been calculated using a 2-degree square box and are provided in the revised response to RAI 2.3.1-1(g).

A copy of the supporting Bechtel calculation will be submitted in a separate letter.

Application Revision

See Enclosure 2 for changes to SSAR Section 2.3.1 and ER Section 2.7 that reflect the responses to RAIs 2.3.1-1 (revised), 2.3.1-2, 2.3.1-3, 2.3.1-4, 2.3.1-5, 2.3.1-6, 2.3.2-1, and 2.3.2-2 contained in this letter.

RAI 2.3.2-1 (NRC 5/12/04 Letter)

Please discuss and provide an evaluation of the potential modification to local meteorological conditions as a result of the presence and operation of a nuclear plant or plants falling within the plant parameter envelope (PPE) specified in the SSAR. Include a discussion on the potential changes in the normal and extreme local meteorological values presented in SSAR Sections 2.3.1 and 2.3.2 resulting from plant construction and operation. The effects of the following on local meteorological conditions should be included in the evaluation:

a) Terrain modifications that would be expected to occur as a result of construction of a nuclear power plant or plants falling within the PPE (e.g., removal of trees, leveling of ground, installation of lakes and ponds).

b) Addition of materials and structures of a nuclear power plant or plants falling within the PPE (e.g., buildings, switchgear, parking lots, roads).

c) Heat and moisture sources that would be expected to result from the operations of a nuclear power plant or plants falling within the PPE.

Response

The presence and operation of new nuclear plant(s) on the ESP site would not cause or contribute to any discernable modifications to the local and regional meteorological conditions including the climatological normals, means, and extremes described in the SSAR Sections 2.3.1 and 2.3.2. This conclusion is based on the findings from an evaluation as summarized below.

1. Terrain Modifications

As described in SSAR Section 2.3.2.4, the ESP site region is characterized by gently rolling terrain averaging between 50 to 150 feet above the mean water level of Lake Anna. The ESP site for new Units 3 & 4 is immediately west of the existing units. The primary topographic influences on local meteorological conditions at the ESP site are associated with the presence of Lake Anna and the North Anna River Valley. Under light wind conditions, there are some channeling effects along the lake and the valley. If there is a sufficient gradient between the ambient air over the lake and surrounding land, a weak lake breeze could develop.

During construction of the new units, a portion of the current undeveloped area of the ESP site would be cleared of existing vegetation (i.e., trees, brush, and grass) and subsequently graded to accommodate the new units and their ancillary structures. No large-scale cut and fill activities would be needed in order to accommodate the new units, since a large portion of the area to be developed is already relatively level. Therefore, the terrain modifications associated with development of the new nuclear power plant(s) at the ESP site would be limited to the existing NAPS site and would not impact terrain features around the lake and/or valley, nor significantly alter the site's existing gently undulating surface that is characteristic of its location in the Piedmont region of Virginia.

2. Addition of Materials and Structures

The dimensions of the new nuclear plant structures and the associated paved, concrete, or other improved surfaces are insufficient to generate discernable impacts to local and regional meteorological conditions. While wind conditions (i.e., speed and direction) may be altered in areas immediately adjacent to the larger site structures, these impacts would likely dissipate within ten-structure heights downwind of the intervening structure. Likewise, since newly paved and concrete site areas would absorb more solar radiation then undeveloped areas, daytime ambient atmospheric temperatures immediately above these improved surfaces could increase. These localized temperature influences would be too limited in their vertical profile and coverage area to alter local ambient or regional temperature patterns.

3. Heat and Moisture Sources

The discharge of heat from operation of the new nuclear power plant(s) to Lake Anna and the atmosphere would not produce discernable impacts to local and regional meteorological conditions (temperature, relative humidity, atmospheric stability, cloud formation, fog, and/or precipitation patterns).

The heat discharged to the WHTF from the Unit 3 open-cycle cooling system would increase reservoir water temperatures and evaporative losses and enhance low-level atmospheric turbulent vertical mixing. Under extreme humidity conditions during fall, winter, and spring, cool moist air above the WHTF could turn to fog and drift to adjacent areas causing localized ground level visibility impairment. However, these induced fogging conditions would most likely coincide with the occurrence of natural fog in the area. Therefore, these effects would not significantly increase the occurrence of local fog. As discussed in ER Section 5.3.2.1.2, maximum daily surface water temperatures resulting from operation of the Unit 3 cooling system would increase over the existing 2-unit operating temperature by 4.6^{0}F at the discharge, 3.6^{0}F near the dam and 2.8^{0}F near the cooling water intake. These small and localized temperature increases would not significantly impact the ongoing moderation of temperature extremes and alterations of wind patterns by the lake.

Similarly, the convective and conductive heat losses to the atmosphere resulting from the Unit 4 closed-loop dry tower system operation would dissipate rapidly through continuous mixing and entrainment with the surrounding moving air mass. Therefore, any increases in overall ambient temperature would be very localized to the North Anna ESP site and would not affect the ambient atmospheric and ground temperatures beyond the site boundary or otherwise significantly alter local temperature patterns.

Application Revision

See Enclosure 2 for changes to SSAR Section 2.3.1 and ER Section 2.7 that reflect the responses to RAIs 2.3.1-1 (revised), 2.3.1-2, 2.3.1-3, 2.3.1-4, 2.3.1-5, 2.3.1-6, 2.3.2-1, and 2.3.2-2 contained in this letter.

RAI 2.3.2-2 (NRC 5/12/04 Letter)

Please identify the air quality characteristics of the site that would be design and operating bases for a nuclear plant or plants that might be constructed on the ESP site.

Response

The ESP site is located within the Northeastern Virginia Intrastate Air Quality Control Region (AQCR). The region is designated as in attainment or unclassified for all criteria pollutants (Reference 1). Attainment areas are areas where the ambient air quality levels are better than the EPA-designated (national) ambient air quality standards. Criteria pollutants are those for which National Ambient Air Quality Standards (NAAQS) have been established [sulfur dioxide (SO_2), fine particulate matter ($PM_{2.5}$ and PM_{10}), carbon monoxide (CO), nitrogen dioxide (NO_2), ozone (O_3), and lead (Pb)] (Reference 2).

The Commonwealth of Virginia is also subject to the revised 8-hour O_3 standard and the new standard for $PM_{2.5}$ (fine particulate matter with an aerodynamic diameter of less than or equal to 2.5 microns), both promulgated by the EPA in July 1997 (Reference 3) (Reference 4). Currently, Louisa County is designated as in attainment for the ozone 8-hour standard (Reference 1). The attainment status for $PM_{2.5}$ standards has not been determined for the Northeastern Virginia Intrastate AQCR or resident ESP site. However, both the Virginia Department of Environmental Quality (VDEQ) recommendations and the EPA response as provided in a "Comparison of state and EPA recommendations" conclude that the entire Northeastern Virginia Intrastate AQCR should be designated in attainment for the fine particulate matter ($PM_{2.5}$) standards (Reference 5). Attainment status designations for this pollutant are expected to be finalized in December 2004.

Finally, the ESP site development could also be influenced by its relative proximity to two pristine regions referred to as Class I areas (James River Face Wilderness and Shenandoah National Park). Maintenance and restoration of visibility is the primary focus in these sensitive areas.

These air quality characteristics would not be a significant factor in the design and operating bases of the new nuclear unit(s). The new nuclear steam supply system and other related radiological systems are not sources of criteria pollutants or other air toxics. The addition of supporting auxiliary boilers, emergency diesel generators, station blackout generators (and other non-radiological emission sources) would not be significant sources of criteria pollutant emissions, because these units operate on an intermittent test and/or emergency basis. Thus, these emissions impact on ambient air quality or visibility in Class I areas would be small, and they are likely to be regulated by the VDEQ via an Exclusionary General Permit – the permit that currently regulates all non-radiological emission sources on the NAPS site.

References

1. 40 CFR 81, Subpart C - Section 107 (40 CFR 81.347): Attainment Status Designations.

2. 40 CFR 50, National Primary and Secondary Ambient Air Quality Standards.

3. 40 CFR 50.7, National 8-Hour Primary and Secondary Ambient Air Quality Standards for Ozone, Code of Federal Regulations, July 18, 1997.

4. 40 CFR 50.10, National Primary and Secondary Ambient Air Quality Standards for Particulate Matter, Code of Federal Regulations, July 18, 1997.

5. EPA-OAQPS—PM2.5 Designations.htm "EPA Responds to States and Tribes - Comparison of state and EPA recommendations". (http://www.epa.gov/pmdesignations/documents/120/revisions.pdf), accessed June 29, 2004.

Application Revision

See Enclosure 2 for changes to SSAR Section 2.3.1 and ER Section 2.7 that reflect the responses to RAIs 2.3.1-1 (revised), 2.3.1-2, 2.3.1-3, 2.3.1-4, 2.3.1-5, 2.3.1-6, 2.3.2-1, and 2.3.2-2 contained in this letter.

RAI 2.4.1-1 (NRC 5/12/04 Letter)

Please provide the following information:

a) Survey coordinates (and associated datum) for the ESP footprint within which all structures, systems, and components important to safety would be located.

b) A drawing showing locations of any existing aquifers in the proposed site area relative to the ESP site footprint.

c) A description or drawing of the likely location of intake tunnels and piping between Lake Anna and the ESP footprint, and conclusions regarding adequacy of space available for this equipment without interfering with the underground piping and structures of existing North Anna, Units 1 and 2.

d) Maximum total service water flow rate for the two existing units, and combined expected service flow rate when all four (2 existing + 2 proposed) units are operating.

e) Documentation of the margin in the available water budget, including allowances for uncertainties associated with future water and land use, to support the cooling water needs (safety and non-safety) for all four (2 existing + 2 proposed) units.

Response

a) Figure 1 identifies the coordinates of the ESP footprint within which all structures, systems, and components important to safety would be located. (Figure 1 is provided at the end of this RAI response.)

b) SSAR Section 2.4.1 references the discussion of regional and local groundwater presented in SSAR Section 2.4.12. Groundwater beneath the ESP site occurs in unconfined conditions in the unconsolidated deposits and bedrock, which form the Piedmont Physiographic Province aquifer system. Other aquifers nearest the site occur in the Coastal Plain Physiographic Province, about 15 miles to the east. Because only a single aquifer underlies the site and there are no other aquifers within about 15 miles, a drawing showing that the entire ESP site is underlain by a single aquifer is not needed.

c) The intake tunnels for Unit 3 would be routed from the ESP intake area south a distance of about 200 feet to the ESP footprint. The discharge tunnel for Unit 3 would be routed from the ESP footprint east a distance of up to about 1800 feet to the ESP discharge. SSAR Figure 1.2-4 shows the locations of the ESP intake area, the ESP footprint, and the ESP discharge. These routings generally coincide with those originally planned for abandoned Units 3 and 4, which were never completed. There is adequate space available for the intake and discharge tunnels without interfering with the underground piping and structures of the existing units.

d) The North Anna Units 1 and 2 service water system is supplied from the service water reservoir. The service water system for Units 1 and 2 is a single, 2-loop system serving both units and is described in detail in the North Anna UFSAR (Reference 1, Section 9.2.1). Each service water loop consists of two 11,500 gpm capacity pumps (for a total of four) powered from the safety related electrical power supplies. These pumps are located in the service water pump house and take suction from the service water reservoir, pump the water through the power block, and return it to the same reservoir. In normal operation, two pumps are running at all times. During a unit shutdown, three pumps operate and in accident conditions, all four pumps would operate.

Additionally, two 11,500-gpm auxiliary service water pumps are located in the intake structure and take suction from Lake Anna. These pumps move untreated water from Lake Anna through the plant and return the water to the WHTF. These pumps are not used for normal operation, as the introduction of untreated water into the system is undesirable, and are intended as a backup to the normal supply outlined above.

For Units 3 and 4, the service water flow path has not been defined. The use and routing of service water is a plant specific design detail that would be established during detailed engineering and described in the COL application. However, the heat loads removed from the plant with the service water system are accounted for in the Plant Parameter Envelope. By definition, the non-safety related service water flows and heat loads are included with the condenser heat loads in the PPE table (see Table 3.1-1, Sections 2.2.2, 2.3.12, 2.4.12, and 2.5 5). The service water flows can be reasonably estimated as approximately 5% of the total circulating water flows.

The safety related service water flows and heat loads are included in the PPE table (Table 3.1-1, Sections 3.2.2 and 3.3.12).

e) ER Section 5.2.1.4 compares the plant water needs to the availability of water supplies. Based on data included in ER Table 5.2-1, the non-safety related cooling water needs for the existing units plus new Units 3 and 4 would be 121 cfs, which includes both natural evaporation from the lake plus the forced evaporation associated with the heat dissipation systems. This value assumes that new Unit 3 would use a once-through cooling system and that new Unit 4 would use a dry tower system. The margin in the available water budget, considering an average net inflow of 370 cfs and a minimum release of 40 cfs, would therefore be 209 cfs. The response to RAI 2.4.11-2 (included in this letter) provides documentation that there would be no significant changes in the inflows to Lake Anna as a result of future urbanization of the watershed. Therefore, the margin in the available water budget to support non-safety-related cooling water needs, considering future water and land use, would not differ significantly from the 209 cfs value cited above.

For existing Units 1 and 2, the service water reservoir serves as the UHS. The maximum water loss that can be expected over a 30-day period after the occurrence of the design basis accident, considering no makeup to the service water reservoir, is 10.9 million gallons (Reference 1, Section 9.2.1.2.2), or 252 gpm (0.56 cfs) on average. Makeup water to the service water reservoir is supplied from Lake Anna. Because there is sufficient water storage in the service water reservoir to maintain Units 1 and 2 in a safe shutdown mode for 30 days, the makeup water that would be used to replenish the service water reservoir while the UHS is in use is not safety-related.

If the reactor designs for new Units 3 and 4 require an UHS, the UHS would consist of a mechanical-draft cooling tower located over a concrete basin water reservoir with sufficient water to maintain the plant in a safe mode for 30 days (see SSAR Section 2.4.11.6). Makeup water to the cooling tower would be supplied from Lake Anna and blowdown would be discharged to the Waste Heat Treatment Facility. As there is sufficient water storage in the basin to maintain the plant in a safe shutdown mode for 30 days, the makeup water that would be used to replenish the basin while the UHS is in use would not be safety-related. Based on information included in ER Tables 3.3-1 and 3.3-2, the evaporation rate from each UHS tower would be 411 gpm (0.92 cfs) during normal plant operation and 850 gpm (1.89 cfs) during upset or abnormal conditions.

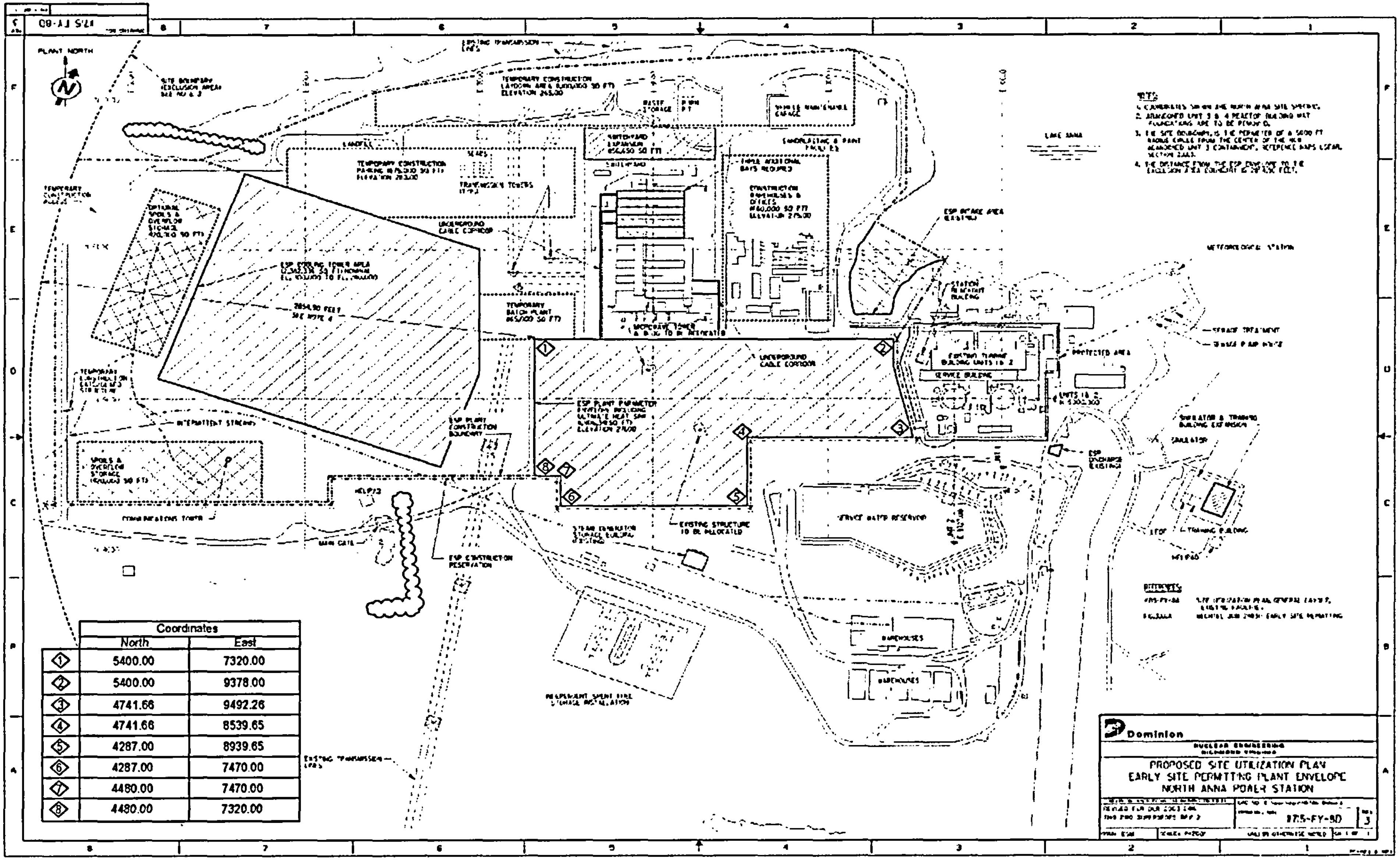
Considering the UHS makeup water requirements when all four units would be operating, up to 1952 gpm (4.35 cfs) could be withdrawn from Lake Anna on a short-term basis if all four units experienced an upset simultaneously. During normal operation of existing Units 1 and 2 and new Units 3 and 4, UHS makeup water requirements would be substantially less. There is ample margin in the available water budget to support UHS makeup water needs during normal operation plant operation as well as during abnormal or upset conditions.

References

1. Updated Final Safety Analysis Report, North Anna Power Station Units No. 1 and 2, Revision 38, Virginia Power.

Application Revision

None.



	Coordinates	
	North	East
1	5400.00	7320.00
2	5400.00	9378.00
3	4741.66	9492.26
4	4741.66	8539.65
5	4287.00	8939.65
6	4287.00	7470.00
7	4480.00	7470.00
8	4480.00	7320.00

Figure 1 Coordinates of ESP Footprint

RAI 2.4.1-2 (NRC 5/12/04 Letter)

SSAR Section 2.4.1 states that during critical low-flow periods, makeup water will be obtained from both North Anna Reservoir and an external source to be identified by the combined license (COL) applicant. Please provide the amount of supplemental cooling water need for this purpose.

Response

The existing SSAR indicates that cooling tower makeup water necessary to replace the water lost to evaporation from the Unit 4 cooling towers would be obtained from Lake Anna and supplemented, as necessary, from an outside source to maintain acceptable lake levels. The SSAR does not identify this outside source. To eliminate uncertainty concerning the adequacy of the Unit 4 makeup water sources, Dominion revised the ESP application to change the base case for heat dissipation for Unit 4 from wet cooling towers to dry towers. Dry tower systems typically have no evaporative water losses, require no makeup water to replace evaporative losses, and have no blowdown discharge compared to mechanical or natural draft cooling towers. In the event that the secondary cooling water loop of the dry tower system selected incorporates a pump sump with a free water surface, a small amount of evaporation would occur. The evaporation from this surface is estimated to be on the order of 1 gpm (0.002 cfs).

This change from wet to dry cooling towers for Unit 4 eliminates the need for obtaining cooling tower makeup water from Lake Anna or from another external source. Consumptive cooling water use for Unit 4 would decrease from about 35 cfs to 0.002 cfs or less during normal plant operation.

Dominion notified the NRC of its intent to use dry towers for Unit 4 in a letter dated March 31, 2004 (Reference 1). As stated in the same letter, the Unit 3 cooling water approach is unchanged. Options for Unit 3 cooling are evaluated in ER Section 9.4.1.1, which concludes that once-through cooling is the environmentally and economically preferable heat dissipation system.

References

1. March 31, 2004 Letter from Eugene S. Grecheck, Vice President-Nuclear Support Services, Dominion, to U. S. Nuclear Regulatory Commission, Document Control Desk, "Dominion Nuclear North Anna, LLC, North Anna Early Site Permit Application, Revised Approach for Unit 4 Normal Plant Cooling," NRC Accession Number ML040980485.

Application Revision

SSAR Section 2.4 will be revised to reflect the change in the Unit 4 cooling approach from wet towers to dry towers. (Note: The affected ER sections were revised in Revision 2 to the ESP Application.)

RAI 2.4.1-3 (NRC 5/12/04 Letter)

SSAR Figure 2.4-10 displays the combined North Anna Reservoir and Waste Heat Treatment Facility stage-storage volume relationship. Please provide a description of the method and the data used to construct this figure. Please include in the figure data for lake volumes down to (at least) stage elevation 219 ft.

Response

The stage-storage curve for Lake Anna for water surface elevations ranging from 200 ft MSL to 270 ft MSL was derived from the 1"= 200 ' contour drawings constructed from aerial photogrammetry of the proposed lake area before the dam was built. Surface areas at elevations 200 ft, 220 ft, 240 ft, 250 ft, 260 ft and 270 ft MSL were measured from the contour drawings (referred to as photo science sheets) using a planimeter, and the incremental volume between two successive contours was determined by assuming a truncated square pyramid. The stage-storage curve was checked for accuracy in two ways: (1) spot checking of surface areas of the photo sheets under various elevation contours using a planimeter; and (2) checking of the area enclosed by the 250 ft MSL contour of a USGS topographic map by a planimeter.

The stage-storage computed values are:

Elevation (feet)	Cumulative Volume (Acre-feet)
200	10,497.20
220	62,815.30
240	195,201.70
250	305,118.55
260	458,057.90
270*	665,147.40

* Note that the North Anna Dam crest elevation is 265 feet. Therefore, actual stage storage volume would be limited to that elevation.

Application Revision

None.

RAI 2.4.1-4 (NRC 5/12/04 Letter)

SSAR Section 2.4.1 provides cooling water withdrawal rates of 2540 cfs for Unit 3 and 44 cfs for Unit 4. Please state whether these rates are based on annual averages or maximums. If they are based on annual averages, please provide estimates for daily maximums. Also, please provide the basis for the consumptive loss associated with Unit 4's cooling tower.

Response

The cooling water withdrawal rate of 2540 cfs (1,140,000 gpm) for Unit 3 is a nominal design coolant flow. This nominal flow would be required during periods of peak lake temperature to maintain condenser vacuum. This value is obtained from SSAR Table 1.3-1, Section 2.5.2. Actual daily maximum circulating water flows would be dependent on the specific design of the circulating water pumps, but would be within a few percent of this value.

With respect to the Unit 4 withdrawal rate and basis for the consumptive loss associated with Unit 4's cooling tower, Dominion revised the ESP application to change the base case for heat dissipation for Unit 4 from wet cooling towers to dry towers. This revision from wet to dry cooling towers for Unit 4 eliminates the need for cooling tower make-up water. A small amount of water, on the order of 1 gpm, may be required in the event that the secondary cooling water loop of the dry tower system selected incorporates a pump sump with a free water surface. See also the response to RAI 2.4.1-2, which is included in this letter.

Application Revision

SSAR Section 2.4 will be revised to reflect the change in the Unit 4 cooling approach from wet towers to dry towers. (Note: The affected ER sections were revised in Revision 2 to the ESP Application.)

RAI 2.4.2-1 (NRC 5/12/04 Letter)

Please provide a description of likely upstream land use changes and changes in downstream water demand that would alter flood risk. Also, please address the impact of factors affecting potential runoff (urbanization, forest fire, or change in agricultural use), erosion, and sediment deposition on the determination of the flood elevation at the site.

Response

A description of likely upstream land use changes and downstream water demand was provided in the response to RAI E4.2.2-2 (Reference 1). The upstream counties, Louisa, Spotsylvania, and Orange, are rural in nature and anticipate some future growth. All three counties are attempting to regulate the growth in specific growth centers near existing towns. The increased impervious areas due to new development would tend to increase runoff potential to local streams and rivers and eventually to Lake Anna. Through storm water management measures that promote detention and infiltration, these impacts can be significantly reduced. Each of the counties plans to implement storm water management measures with future development. While the future development in the watershed would tend to increase runoff to Lake Anna during a flooding event, the impact on the inflow and runoff volume to the lake would be small due to the relatively low percentage of overall development and the low density of the projected development in the watershed.

In addition to urbanized development, other changes to the watershed that could adversely affect the flood elevation at the site would be deforestation of large areas due to fire or conversion of forestland to agricultural purposes. Current regulations in the upstream counties make the likelihood that large tracts of forest would be converted to agricultural purposes very remote. However, a large forest fire in the watershed could have an impact on the flood elevation at the site, as runoff from the fire area would increase until the forest has been re-established. Erosion in the area of the fire would also increase and increase the sediment deposition in the lake. Since lake water level is maintained at Elevation 250.0 msl, and the flood level determination for Lake Anna assumed this elevation for a starting water level, the increased sediment would not affect the flood level determination.

Directly connecting drainage structures to existing streams and rivers would also increase runoff from urbanized areas by eliminating flow over surfaces that promote infiltration. Most of the projected development for the upstream counties is anticipated to be residential in nature. Generally, directly connected drainage structures are not used in residential areas. Also, each county has adopted regulations that encourage the use of storm water management measures that promote detention and infiltration.

Currently there are no water users that withdraw water directly from Lake Anna other than the North Anna Power Station. There are other water users withdrawing water downstream of the North Anna Dam. Since the flow from the dam is regulated and the water level in the lake is maintained at Elevation 250.0 ft msl, increases in water demand downstream of the dam would have no impact on the flood level determination at the ESP site. The increased water demand for the operation of the proposed Unit 3 would affect the water level of the lake during low flow periods. During low flow periods with operation of Unit 3, there could be longer periods of time when the lake water level is below elevation 250.0 ft msl. This would increase the likelihood the lake level would be below 250.0 ft msl if a flood event occurred. Consequently, more storage would be available in the lake and the flood level at the site would be reduced. However, for the purpose of determining the site probable maximum flood (PMF) elevation, the lake level is assumed to be at Elevation 250.0 ft msl and the predicted PMF elevation is not reduced due to Unit 3 operation.

References

1. May 17, 2004 Letter from Eugene S. Grecheck, Dominion, to U. S. Nuclear Regulatory Commission, Document Control Desk, "Dominion Nuclear North Anna, LLC, North Anna Early Site Permit Application, Response to Request for Additional Information Regarding Environmental Portion of ESP Application," NRC Accession Number ML041450041.

Application Revision

None.

RAI 2.4.2-2 (NRC 5/12/04 Letter)

Please describe the methodology for documenting historical hill slope failures in the watershed (interviews, literature reviews, web searches, etc.). Please include, for all documented hill slope failures, both the failure mechanism and hill slope properties (e.g., terrain grade, drainage, and soil type).

Response

Landslide hazards were investigated in the North Anna site area to assess the potential for landslide-induced flooding at the North Anna site. Scenarios for possible landslide-induced flooding at the site include landslide diversion of local drainages in the site area and landslide-induced seiches within Lake Anna. The methodology for assessing landslide potential in the Lake Anna area included: field reconnaissance, air-photo interpretation, literature search for available information on landslides, review of existing literature, and discussions with researchers familiar with the site region. Air photos reviewed included U.S. Geological Survey 1:19,000 scale, black and white photography obtained in 1966 (3/19/66), Frames 1-148 to 1-154 and NAP 1:40,000 scale, black and white photography obtained in 2000, Frames 42 to 44. Researchers contacted included Dr. Gerry Wieczorek, U. S. Geological Survey, Dr. Scott Eaton, James Madison University, and Dr. Chuck Bailey, College of William & Mary.

Results from this investigation show that large, deep-seated landslides are not present in the North Anna site area or along the shores of Lake Anna. The gently rolling topography prevalent in the Piedmont region of Lake Anna generally is not susceptible to deep-seated landslides or to extensive debris flows. There are no published maps of landslides in the Lake Anna area, similar to other parts of Virginia (e.g., References 1 and 2), primarily because landslides are not prevalent in the region. Based on field reconnaissance and air-photo interpretation, there are no observed landslides in the Lake Anna region other than sparse minor debris flows, soil slips, and rock falls.

Given the absence of observed landslides in the Lake Anna region, and the gently rolling topography, there is no potential for large, deep-seated landslides or debris flows to impound local drainages in the North Anna site area or to produce a seiche within Lake Anna. Metamorphic bedrock in the site area is deeply weathered to a saprolitic soil. The saprolite erodes primarily by sheetwash and downslope colluvial transport and locally by stream and gulley incision. This type of erosion leads to the development of gently rolling topography. There are no steep to over steepened slopes in the site area or along the shores of Lake Anna. Evaluation of pre-Lake Anna photography also shows that there are no large over steepened slopes submerged beneath the lake.

References

1. Morgan, B.A., Wieczorek, G.F., Campbell, R.H., and Gori, P.L., 1997, Debris-Flow Hazards in Areas Affected by the June 27, 1995 Storm in Madison County, Virginia; U.S. Geological Survey Open-File Report 97-438.

2. Morrissey, M.M., Wieczorek, G.F. and Morgan, B.A., 2001, A Comparative Analysis of Hazard Models for Predicting Debris Flows in Madison County, Virginia; U.S. Geological Survey Open-File Report 01-0067.

Application Revision

None.

RAI 2.4.2-3 (NRC 5/12/04 Letter)

Please describe the methodology for documenting seismically induced seiches in the Lake Anna Reservoir (interviews, web searches, etc.). Please address any evidence of historical seismically induced seiche in the area, including a description of the seismic event, land damage, date of occurrence, etc.

Response

A search of existing literature was performed to determine if any seismically induced seiches have occurred in Lake Anna or any other lake in the area. Since the occurrence of seiches and other seismic wave activity (tsunamis) are extremely rare in the eastern United States, limited information is available on the subject. A recent paper published in the Science of Tsunami Hazards, the International Journal of the Tsunami Society, lists all the known reports of tsunamis or tsunami like (including seiches) waves that have occurred in the eastern U.S. since 1600 (Reference 1). This document references several other documents and articles that have been published also describing seismic wave activity in the U.S. A review of the paper indicates that no seiche activity, either seismically or otherwise induced, has been identified in the Commonwealth of Virginia, including Lake Anna.

Additionally, North Anna plant personnel have not reported any seiches on Lake Anna. Searches for seiche information on the Internet also did not produce any information regarding reports of seismically induced seiches in the area of the North Anna ESP site.

References

1. Lockridge, Patricia A., Whiteside, Lowell S., Lander, James F. "Tsunami and Tsunami-Like Waves of the Eastern United States," Science of Tsunami Hazards, Volume 20, Number 3, pg 120, 2002.

Application Revision

None.

RAI 2.4.2-4 (NRC 5/12/04 Letter)

Please describe why drainage capacity at the existing grade is sufficient to accommodate local intense precipitation. If capacity is not sufficient, please describe (in sufficient detail to show feasibility) any active safety-related drainage systems proposed for the new units. In addition, please indicate whether or not drainage from the proposed site will be accomplished through a drainage canal under the existing railroad spur.

Response

The existing railroad spur, which is located north of the proposed location for the new units and south of Lake Anna at the proposed intake location, is at Elevation 270.0 ft msl. An existing road adjacent to and north of the railroad is at Elevation 271.0 ft msl. The existing grade at the proposed location for the new units, south of the railroad spur, is presently at about Elevation 250.0 ft msl. This area was excavated for the construction of foundations for additional units in the 1980s. The construction of these units was abandoned shortly after the excavation for the foundations occurred. For the construction of the new units, the existing excavation would be used for the placement of foundations and then filled to an elevation of 271.0 ft msl. The existing grade south of the excavation ranges gradually from Elevation 274.0 ft msl to Elevation 271.0 ft msl.

Once the existing excavation is filled, the final site grade would gently slope from south to north towards Lake Anna. The determination of the final grade for the proposed new units would be determined in conjunction with the detailed analysis of the drainage for the local intense precipitation, which is the local probable maximum precipitation (PMP) defined in SSAR Section 2.4.2.3. Drainage for local intense precipitation would be accomplished using surface ditches and swales. The locations, sizes, and design for these ditches would be determined as part of detailed engineering when a reactor type and final layout have been selected.

If the existing railroad spur remains in place, drainage culverts would be provided. However, flood level analyses from local intense precipitation would assume that the culverts are blocked. Grading would be provided near the railroad spur to allow drainage to flow over the railroad spur and road. Grading downstream of the road would be provided to direct the overflow to a surface ditch that would discharge to Lake Anna. Flood elevations in the plant area would then be determined based on the flow over the spur and road and the plant grade would be set such that flooding of safety-related facilities is prevented based on the calculated flood elevations.

Another potential arrangement would be to remove the railroad spur in front of the proposed site and place a low water crossing for the existing road. In this arrangement, a wide drainage canal would be provided at an elevation lower than the existing road grade to allow runoff to discharge to Lake Anna. The slope of this drainage canal at the road section would be gentle enough to allow vehicular traffic pass through the canal. A storm drain would be provided beneath the drainage canal to allow flows from less severe storms to be collected and discharged without causing flow over the road. The road crossing for the discharge canal would be designed such that depth of flow would be low enough to permit vehicular traffic even during the local probable maximum precipitation.

For either arrangement, slab and entrance/doorway curb elevations for safety-related facilities would be placed above the flood elevations determined as the result of local intense precipitation to prevent flooding of safety-related facilities.

Application Revision

None.

RAI 2.4.3-1 (NRC 5/12/04 Letter)

Please provide a calibrated unit hydrograph definition, expressed in terms of input parameters for the Hydrologic Engineering Center watershed modeling code (HEC-1), for an adjacent unregulated basin of size similar to the one in which the site is located, or explain why such a hydrograph is not necessary or appropriate.

Response

The input parameters that define a unit hydrograph such as the Clark Synthetic Unit Hydrograph typically include the time of concentration (T_c) and storage coefficient (R) (Reference 1). These parameters define the shape of the unit hydrograph used to determine the discharge hydrograph of a basin from a rainfall event.

The calibrated unit hydrograph used in the PMF analysis and presented in SSAR Section 2.4.3 was developed to reflect the inflow to Lake Anna and only represents the overland portion of the basin. This unit hydrograph would have a relatively short time of concentration parameter, if developed using a Clark Synthetic Unit Hydrograph as the presence of Lake Anna shortens the flow paths from all points in the basin. A separate unit hydrograph, which reflects an instantaneous response to the rainfall, is used to depict the rainfall directly over Lake Anna. The discharge hydrographs produced by these two unit hydrographs are added to determine the inflow hydrograph to Lake Anna in the runoff model.

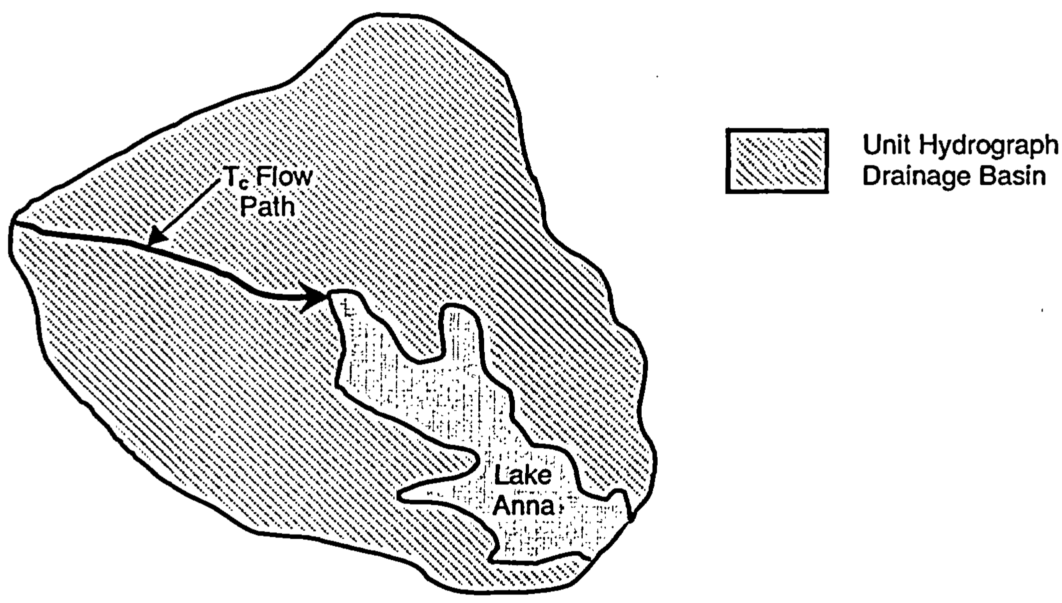
The unit hydrograph developed for an unregulated basin of similar size and slope would have a different time of concentration than that of the inflow basin to Lake Anna. (See Figure 1 at the end of this RAI response for a schematic representation of the two basins.) Thus, the resulting unit hydrograph would also be different from the one developed for Lake Anna. The application of such a unit hydrograph for an adjacent unregulated basin to the Lake Anna basin would not be appropriate.

The unit hydrograph developed for the Lake Anna inflow was based on actual rainfall data and observed water level and discharge data measured at North Anna Dam. Because it is based on actual observed responses in the basin studied and not on correlations with nearby drainage basins, the hydrograph is more representative of the Lake Anna basin rainfall response.

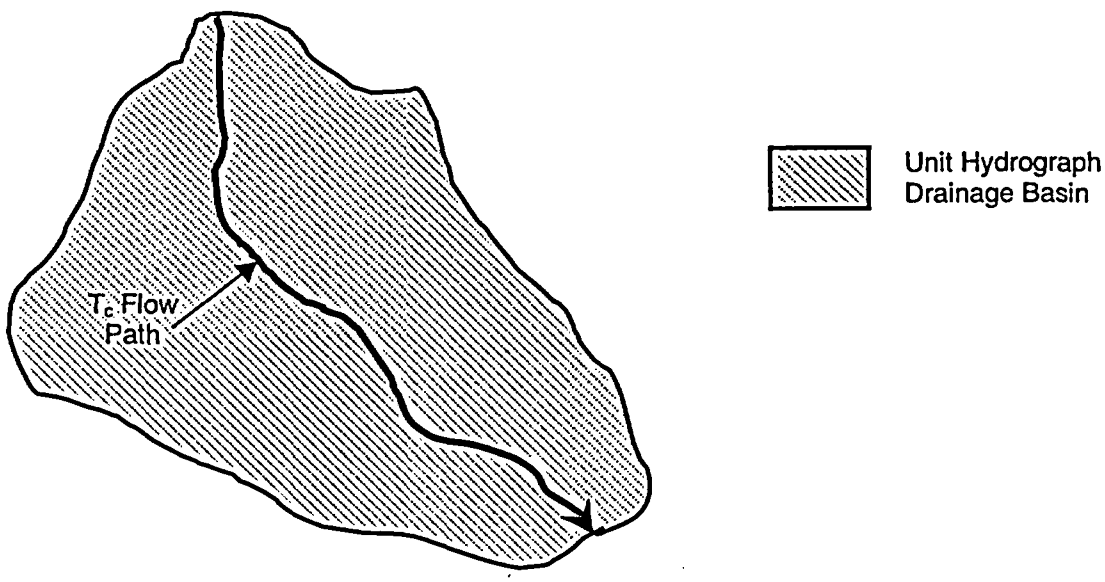
References

1. Computer Program 723-X6-L2010, HEC-1 Flood Hydrograph Package, Version 4.0, Computer Program User's Manual, Hydrologic Engineering Center, U.S. Army Corps of Engineers, September 1990.

Figure 1. Schematic Representation of North Anna Basin and Typical Unregulated Basin. (Note: The schematics do not depict actual basin sizes and shapes, but are representations of typical regulated and unregulated basins.)



North Anna Basin Schematic



Typical Unregulated Basin Schematic

Application Revision

None.

RAI 2.4.3-2 (NRC 5/12/04 Letter)

SSAR Section 2.4.3 describes the use of the HEC-1 computer program for computing runoff from the watershed and routing the PMF. Please provide the supporting input files and the software version information used to generate the results discussed in these sections.

Response

The HEC-1 input files described in SSAR Section 2.4.3 are contained on the enclosed compact disk (CD). There are four HEC-1 input files listed and described below:

File Name	Description
79REV1.IH1	1979 Storm Calibration
94REV1.IH1	1994 Storm Calibration
95REV1.IH1	1995 Storm Calibration
PMPREV1.IH1	PMP Runoff Model

These input files were used in the computer program HEC-1, Flood Hydrograph Package, version 4.0.1E, produced by the U.S. Army Corps of Engineers, to determine the watershed runoff hydrograph, perform flood routing, and determine the lake water levels described in SSAR Section 2.4.3. Version 4.0.1E contains an expanded array as compared with Version 4.0, which allows use of larger hydrographs (2000 ordinates versus 300).

Application Revision

None.

RAI 2.4.4-1 (NRC 5/12/04 Letter)

Please document the impounded volumes and the locations of Lake Louisa and Lake Orange relative to those of Lake Anna. Also, please describe the methodology for documenting impacts of failure of dams on these lakes on the proposed units.

Response

Lake Louisa is located on Hickory Creek, a tributary to the North Anna River, about 3.4 miles upstream of Lake Anna and 15.4 miles upstream of the proposed North Anna ESP site. The lake has a surface area of 280.0 acres and a maximum impounded storage volume of 4,713.0 acre-ft (Reference 1).

Lake Orange is located on Clear Creek, a tributary to Pamunkey Creek, which is a tributary to Lake Anna. The lake, which is located about 8.8 miles upstream of Lake Anna and 18.9 miles upstream of the proposed North Anna ESP site, has a normal surface area of 120.0 acres and a maximum impounded volume of 2958.0 acre-ft (Reference 1).

The storage volume available in Lake Anna between the top of the dam at Elevation 265.0 ft msl and the normal water level at Elevation 250.0 ft msl is about 245,000 acre-ft (ER Section 2.3.1, Table 2.3-1). The combined storage volume of these two lakes is 7671 acre-ft. With Lake Anna at a normal water level, the storage and discharge capacity of the reservoir is more than sufficient to store and/or discharge the floods generated by the failure of one or both of these dams.

The more critical situation would be the failure of these dams during the probable maximum flood (PMF) event. The Lake Anna PMF still water flood level at the ESP site was determined to be Elevation 264.27 ft msl (Elevation 264.07 ft msl at the dam). At this elevation, Lake Anna has a surface area of approximately 19,400 acres (Reference 2, Figure 2A-2). Conservatively assuming that both dams fail such that the inflows from the dam breaches reach Lake Anna at the same time as the peak water level from the PMF occurs and conservatively assuming that there is no discharge from Lake Anna at this point, the increased water level in the lake due to these combined volumes would be about 0.40 ft. Adding this value to the peak flood level at the ESP site gives a flood level of Elevation 264.67 ft msl, which is below the proposed site grade elevation of 271.0 ft msl. However, the peak discharge at the maximum PMF level from Lake Anna is 141,000 cfs. Thus, in reality, the increased water levels in Lake Anna due to failure of either of these dams would be less than the water level increase listed above and would not affect the proposed ESP site. Additionally, the flood waves generated by failures of Lake Louisa Dam and Lake Orange Dam would pass through approximately 12 miles and 10.1 miles of Lake Anna, respectively. The long travel lengths through Lake Anna would dampen the flood waves generated by the relatively small storage volumes in Lake Louisa and Lake Orange resulting in no impact to the site.

References

1. U. S. Army Corps of Engineers, National Inventory of Dams, available at http://crunch.tec.army.mil/nid/webpages/nid.cfm, accessed on February 24, 2004.

2. Updated Final Safety Analysis Report, Rev. 38, North Anna Power Station, Virginia Power.

Application Revision

None.

RAI 2.4.4-2 (NRC 5/12/04 Letter)

SSAR Section 2.4.4 describes use of a mechanical draft cooling tower over a buried water storage basin. Please provide design parameters, such as basin depth, for this underground basin.

Response

For those units that require a conventional ultimate heat sink (UHS), a mechanical draft cooling tower over an underground basin would be used. A separate cooling tower and basin would be provided for each unit. Each basin would be sized to store a 30-day supply of emergency cooling water to maintain the unit in a safe shutdown condition. The bounding storage volume from the plant parameters envelope (SSAR Table 1.3-1, Item 3.3.16) for each basin is 30,600,000 gallons (4,090,625 ft^3). The estimated dimensions of the UHS cooling tower basin are approximately 235 ft wide by 350 ft long by 50 ft deep. Additional basin depth would be provided, as necessary, for freeboard and a possible frozen surface layer in the basin. Makeup water for the UHS cooling tower basins would be obtained from Lake Anna. The final size and design for the UHS basins and cooling towers would be determined as part of detailed engineering and described in the COL application.

Application Revision

None.

RAI 2.4.7-1 (NRC 5/12/04 Letter)

Please provide details, including location, duration, and height, on the occurrence of ice dams and subsequent downstream flood waves in the region.

Response

There are no historical records indicating the formation of ice dams in the North Anna River, and any subsequent downstream flood waves resulting from such an event, according to records maintained by or available to Dominion.

Application Revision

None.

RAI 2.4.7-2 (NRC 5/12/04 Letter)

SSAR Section 2.4.7.4 states that formation of anchor ice on the trash racks and screens would be assessed during design of the intake structures by the COL applicant. Please provide site characteristics relevant to such an assessment, including ice anchor thickness and potential ice depth.

Response

Site characteristics relevant to the assessment of anchor ice include the historic minimum and mean low daily temperature data. They are presented in SSAR Section 2.4.7.5, Table 2.4-13. In general, the site characteristics are not conducive to the formation of anchor ice on the trash racks and screens at the intake structures. There is no historical record indicating the formation of frazil ice in the existing intake structure according to plant records. The statements in SSAR Section 2.4 referring to the possible formation of frazil ice, and thus possibly anchor ice on the trash racks and screen in the intake structures, are for circumstances which are extremely rare, such as the unlikely event when all the units do not operate for a prolonged periods of time during very severe wintry conditions. When any of the units is in operation, the heat loads dissipated in Lake Anna by the circulating cooling water would preclude the formation of any frazil ice, and thus the possibility of anchor ice, on the trash racks and screens of the intake structures. An assessment would be made during detailed engineering to determine if anchor ice could form on the intake structure during extreme wintry conditions when all units at North Anna are shut down. If that assessment indicated possible anchor ice formation, measures would be included in the design to preclude its formation. Therefore, an assessment to determine the thickness of anchor ice at the intake structures is not necessary, as the design would preclude its formation.

Application Revision

None.

RAI 2.4.7-3 (NRC 5/12/04 Letter)

SSAR Section 2.4.7.5 states that emergency cooling and service water needed to maintain the proposed units in a safe mode would be supplied by a separate ultimate heat sink (UHS). Please describe the source of the cooling water that would be used for this purpose.

Response

For those units that require a conventional ultimate heat sink (UHS), a mechanical draft cooling tower over an underground basin would be used. A separate cooling tower and basin would be provided for each unit. The minimum volume of the cooling tower basin UHS depends on the type of reactor selected for this project. According to SSAR Table 1.3-1, Section 3.3.16, the required 30-day water storage is 30,600,000 gallons. The UHS would be filled prior to plant start up. The initial filling and makeup water for the UHS cooling tower basins would be obtained from Lake Anna.

Application Revision

None.

RAI 2.4.7-4 (NRC 5/12/04 Letter)

SSAR Section 2.4.7.5 states that both emergency and service water will be provided by the UHS, and that safety-related facilities will not be affected by ice floe accumulation. Please identify the minimum volume of the UHS, and indicate the maximum depth of ice formation in the water stored in the UHS that will ensure protection from freezing or ice formation.

Response

The minimum volume of the cooling tower basin UHS depends on the type of reactor selected for this project. According to SSAR Table 1.3-1, Section 3.3.16, the required 30-day water storage is 30,600,000 gallons. Any ice formation or buildup in the basin would be accounted for in the detailed design of the UHS, either by providing sufficient depths with the minimum volume of water for the UHS stored below the ice formation, or other measures to preclude the possibility of ice formation or buildup on the surface of the UHS.

Application Revision

None.

RAI 2.4.7-5 (NRC 5/12/04 Letter)

SSAR Section 2.4.7.6 states that the PPE snow load is 50 pounds per square foot. Please explain how the local snow load (site characteristic) was calculated. If it was not calculated via the meteorological attributes discussed in Section 2.3.1.3.4, please justify why not.

Response

In the revised response to RAI 2.3.1-1 included in this letter, the weight of the 100-year return-period snow pack is given as 30.5 pounds per square foot and the 48-hour winter Probable Maximum Precipitation (PMP) is given as 20.75 inches. The revised RAI 2.3.1-1 response explains how the weight of the local snow pack and the PMP value were calculated. The value of 50 pounds per square foot given in SSAR Table 1.3-1, Section 1.2.2, is the maximum load on structure roofs due to the accumulation of snow and ice that is allowable by the bounding plant design considered in the ESP application. The COL application would describe the design features that demonstrate acceptable structure performance of the selected design.

Application Revision

SSAR Section 2.4.7.6 will be revised to read as follows:

2.4.7.6 **Ice and Snow Roof Loads on Safety Related Structures**

Historical data indicate that since the existing units were put into operation, snowfall in Richmond and at the ESP site has been infrequent and without debilitating impacts when compared to other "snow" regions in the country, as discussed in Section 2.4.7.3. The presence of snow/ice accumulation could cause blockage of the roof drains and its effects must be considered in the design of the roofs of the safety related structures.

According to RG 1.70, Section 2.3.1.2, the weight of a 48-hour winter Probable Maximum Precipitation (PMP) and the weight of a 100-year return-period snow pack should be considered for the design of the roofs of safety-related structures. Based on the climatological conditions at the site, the weight of a 100-year snow pack is estimated to be 30.5 pounds per square foot and the 48-hour winter Probable Maximum Precipitation (PMP) is estimated to be 20.75 inches, as indicated in Section 2.3.1.

The maximum load experienced by the roof structure, due to precipitation, is dependent on the roof design/configuration. For example, the roof load could be governed by the maximum accumulation of snow and a surcharge due to the loading from the overflow depth as runoff flows over the roof. The design capacity of the roof structure, and possibly other design features, which demonstrate acceptable roofing structure performance for the selected reactor design, would be described in the COL application.

RAI 2.4.9-1 (NRC 5/12/04 Letter)

Please provide information regarding whether there is any historical or geological evidence of the North Anna River meandering or being diverted or meandering upstream of the proposed site.

Response

As stated in SSAR Section 2.4.9, the possibility of an upstream diversion of the North Anna River is considered extremely remote. Cooling water for the existing units is drawn from Lake Anna. Lake Anna is fed primarily by the North Anna River, and a series of smaller tributary streams. The lake currently inundates the former river valley to a depth of approximately 50 to 60 feet in the site vicinity.

For those new units that require a conventional ultimate heat sink (UHS), a mechanical draft cooling tower over an underground basin would be used. A separate cooling tower and basin would be provided for each unit. Makeup water for the UHS cooling tower basins would be obtained from Lake Anna. The UHS would be filled prior to plant start up and would be isolated from future potential diversions of Lake Anna water as an emergency cooling backup.

Inspection of topographic maps, geologic maps, and pre-Lake Anna aerial photography show that the North Anna River flows within a large drainage basin, and that there is no apparent natural or manmade mechanism that could divert the river out of its drainage basin. Thus, the flow of water into Lake Anna from the North Anna River and its tributaries is secure from unexpected upstream diversions. Topographic maps inspected include the 1:100,000 scale 30 x 60 minute US Geological Survey Fredericksburg and Charlottesville quadrangles and the 1:24,000 scale, 7.5-minute U. S. Geological Survey Orange, Lahore, Mineral, Lake Anna West and Lake Anna East quadrangles. Aerial photography consisted of stereo-paired USGS black and white (B&W) imagery at a scale of 1:19,000 (Table 1). The photography was flown in 1963 and 1966 and predates the filling of Lake Anna and construction of the North Anna Power Station. These photos cover the entirety of the Lake Anna West 7.5-minute quadrangle and significant portions of the adjacent Lake Anna East, Belmont, Brokenburg and Beaverdam 7.5-minute quadrangles. Geologic maps of the site area inspected include the 1:100,000 scale maps of the Fredericksburg (Mixon et al, 2000) and Richmond (Marr, 2002) quadrangles as well as the 1:24,000 scale map of the Lake Anna East quadrangle (Bobyarchick, 1981).

Table 1. USGS Aerial Photography Reviewed (1:19,000 Scale)

Date	Quadrangle	Type	Project	Frames
3/4/63	Belmont	B&W	GS-VAQV	4-3 to 4-5 4-21 to 4-25 4-29 to 4-31 4-50 to 4-52
3/3/63	Brokenburg	B&W	GS-VAQV	3-228 to 3-229 3-264 to 3-266
3/29/66	Lake Anna West	B&W	GS-VBKG	1-83 to 1-90 1-148 to 1-154 2-35 to 2-42 2-97 to 2-106 2-158 to 2-166
3/3/63	Lake Anna East	B&W	GS-VAQV	3-215 to 3-217 3-221 to 3-223 3-272 to 3-274
3/17/66	Beaverdam	B&W	GS-VBIZ	2-226 to 2-229 2-261 to 2-262 3-40 to 3-42

Interpretation of the topography and geomorphology from these maps and photos shows that the North Anna River and larger tributaries (e.g., Pamunkey Creek, Terry's Run, Plentiful Creek, Contrary Creek, etc.) upstream of Lake Anna flow in valleys generally 1/8 to 1/4 mile wide, and up to 1/2 mile wide. Large meander bends and stream terraces are preserved along these drainages and are submerged beneath Lake Anna. The drainage divide that defines the North Anna drainage basin generally is over 250 feet higher than the river. The presence of common Miocene gravel deposits and lag gravels along ridgelines and broad surfaces in the Lake Anna region suggest that the drainage network has remained fairly constant during post-Miocene incision. The absence of post-Miocene deposits mapped in interfluve areas indicates that any Pliocene, Pleistocene, or Holocene channel diversions have been relatively minor and confined to the bottoms of existing drainages. There is no potential for an earthquake, subsidence event, landslide, or ice blockage to divert the river out of this well entrenched drainage pattern.

References

Bobyarchick, A. R., Pavlides, L., and Wier, K., 1981, Piedmont geology of the Ladysmith and Lake Anna East quadrangles, and vicinity, Virginia, U.S. Geological Survey Miscellaneous Investigations Series Map I-1282, 1:24,000 scale.

Marr, J.D., 2002, Geologic Map of the Western Portion of the Richmond 30' x 60' Quadrangle, Virginia, Virginia Division of Mineral Resources, Publication 165.

Mixon, R.B., L. Pavlides, D.S. Powars, A.J. Froelich, R.E. Weems, J.S. Schindler, W.L. Newell, L.E. Edwards, and L.W. Ward, 2000, Geologic Map of the Fredericksburg 30' x 60' Quadrangle, Virginia and Maryland, U.S. Geological Survey, Geologic Investigations Series Map I-2607.

Application Revision

SSAR Section 2.4.9 will be revised to read as follows:

2.4.9 Channel Diversions

The possibility of an upstream diversion of the North Anna River is considered extremely remote. Historical information indicates that the river has not had a major change of course in recent history (Reference 1) (Reference 6). Inspection of US Geological Survey 7.5-minute topographic maps and pre-Lake Anna aerial photography shows that the North Anna River lies in a valley that is at least 250 feet lower than the surrounding drainage divide. There is no apparent manmade or natural event (e.g., earthquake, subsidence, landslide or ice blockage) that could divert the North Anna River from its current drainage basin. Thus, the flow of water into Lake Anna from the North Anna River and tributaries is secure from unexpected upstream diversions.

RAI 2.4.11-1 (NRC 5/12/04 Letter)

Please discuss the critical ambient conditions that might limit operation of the UHS or constrain safety-related cooling tower design. One example might be a specific combination of temperature and relative humidity.

Response

The critical ambient conditions that might limit the operation of the UHS cooling-tower design are provided in the revised response to RAI 2.3.1-1 Part f), which is included in this letter. The meteorological conditions that would result in the maximum evaporation and drift loss of water from the UHS and the minimum cooling by the UHS are the critical wet and dry bulb conditions for the UHS cooling tower design.

Application Revision

None.

RAI 2.4.11-2 (NRC 5/12/04 Letter)

Please describe likely upstream land use changes and changes in downstream water demand that would likely alter the intensity or frequency of low-flow conditions. Also, please calculate the availability of cooling water during critical low-flow periods, including sufficient margins to account for future urbanization of the watershed. These margins should be based upon available county and/or state growth management plans.

Response

The response to RAI E4.2.2-2 (Reference 1) provides a description of the projected upstream development based on available county comprehensive growth plans. The response also describes the impacts of future development on the low water condition of Lake Anna.

In summary, the response indicates that all three upstream counties (Louisa, Orange, and Spotsylvania) anticipate future growth and development. Each county is rural in nature and plans to limit growth to areas near existing towns and growth centers. Increased development would impact the low-flow condition by increasing groundwater withdrawal to meet the demand of future growth and decreasing the infiltration to groundwater by increasing impervious areas. Decreases in groundwater could then decrease stream flow into Lake Anna during the low-flow condition. However, the increased development in the counties located in the watershed is small relative to the size of the watershed and thus, the impact on the low-flow condition would be small.

The availability of cooling water during low-flow conditions has been considered in the water balance model presented in ER Section 5.2.2. A summary of the results produced in this model is also presented in SSAR Section 2.4.11. The Lake Anna inflows used in this model are based on historic lake, dam operating, and plant operating data. Since the impact due to development in the upstream watershed is anticipated to be small, it would not significantly affect the availability of cooling water during low-flow conditions and the model results presented would be an accurate representation of the Lake Anna low-water condition with the anticipated future development. A discussion on the margins available in the cooling water supply is presented in the response to RAI 2.4.1-1, which is included in this letter.

References

1. May 17, 2004 Letter from Eugene S. Grecheck, Dominion, to U. S. Nuclear Regulatory Commission, Document Control Desk, "Dominion Nuclear North Anna, LLC, North Anna Early Site Permit Application, Response to Request for Additional Information Regarding Environmental Portion of ESP Application," NRC Accession Number ML041450041.

Application Revision

None.

RAI 2.4.12-1 (NRC 5/12/04 Letter)

SSAR Figure 2.4-15 reports data between December 2002 and June 2003. Please update the figure with piezometer data from June 2003 to September 2003, and piezometer data prior to December 2002, if it exists, or explain how this span of data represents the seasonal variation in groundwater and how the ESP subsurface investigation program is appropriately consistent with previous groundwater measurements.

Response

SSAR Table 2.4-15 and Figure 2.4-15 will be updated to include the fourth round of groundwater level measurements taken at the North Anna site on September 29, 2003.

SSAR Table 2.4-15 shows that groundwater levels in wells OW-841, 843, 844, 845, 846, and 849 peaked at the June reading, while levels in OW-842, 847 and 848 continued to rise through September. The wells that peaked in June show a maximum water level fluctuation for the year over which measurements were taken of 6.2 feet (OW-849) while the wells that were still rising show a maximum increase of 5.4 feet (OW-847) over the year. Groundwater level measurements in piezometers installed around the existing service water reservoir at the site have been recorded since the mid-1970s to, among other things, assess seepage from the reservoir. Three of these piezometers, P-10, P-14 and P-18, have the longest continuous record of groundwater level measurements at the site (Figures 1 through 3; figures are located at the end of this RAI response). P-14 exhibits the maximum groundwater level fluctuation of about 10 feet since 1976 (Figure 1). Note that the lowest elevation recorded in this piezometer, in 1992, has been discounted as a potentially erroneous measurement due to its inconsistency with measurements taken before and after it. Piezometers P-10 and P-18 exhibit maximum fluctuations of about 8 and 6 feet, respectively, over this same period of time (Figures 2 and 3). Due to their location around the service water reservoir, the water levels recorded in these piezometers may, to some extent, reflect the effect of seepage from the reservoir on localized groundwater levels. However, these long-term measurements indicate that the quarterly measurements recorded for the ESP application appear to generally reflect the magnitude of groundwater level fluctuations on a yearly basis, but maximum groundwater level fluctuations that are likely to occur at the North Anna site over a much longer period of time may be about 60 percent greater than those measured during the one-year ESP recording period.

Groundwater flow prior to the filling of Lake Anna was determined to be toward the North Anna River or its tributaries, as stated in SSAR Section 2.4.12.1.2. The ESP investigation determined that current groundwater flow at the site is generally to the north and east, toward Lake Anna. Thus, the general direction of groundwater flow has remained constant since before construction of the existing units to the present time. In addition, the current groundwater piezometric surface at the site ranges from about Elevation 250 ft msl to Elevation 300 ft msl, as shown on SSAR Figure 2.4-16. These elevations are in the same range as those shown on piezometric contour maps of the site prepared prior to construction of the existing units and the filling of Lake Anna. (References 1 and 2) However, due to grading operations for the existing units that have reconfigured the land surface at the site, construction of the existing cooling water discharge canal, the filling of Lake Anna, seepage from the service water reservoir, and horizontal drains installed beneath the existing units' service water pump house to control groundwater levels in this area, some adjustment in the local groundwater flow pattern and elevation has occurred to accommodate and reflect these changes. Therefore, groundwater levels reported in References 1 and 2 are not necessarily comparable with groundwater levels measured subsequent to the construction of Units 1 and 2.

<u>References</u>

1. Report, Site Environmental Studies, Proposed North Anna Power Station, Louisa County, Virginia, (included in Units 1 and 2 PSAR as Appendix A), Dames & Moore, January 13, 1969.

2. Report, Site Environmental Studies, North Anna Nuclear Power Station, Proposed Units 3 and 4, Louisa County, Virginia, Dames & Moore, August 18, 1971.

Application Revision

The 5th paragraph of SSAR Section 2.4.12.1.2 will be revised to read as follows:

> Groundwater at the ESP site occurs in unconfined conditions in both the saprolite and underlying bedrock. The results of previous investigations at the site indicate that a hydrologic connection exists between the saprolite and the bedrock. (Reference 45) This condition has been confirmed as part of the ESP subsurface investigation program (Appendix 2.5.4 B) by the presence of nearly equal water level elevations recorded in two observation wells (OW-845 and OW-846, Table 2.4-15) installed adjacent to each other and sealed in the bedrock and saprolite, respectively. At the ESP site, the water table is considered to be a subdued reflection of the ground surface and, therefore, the direction of groundwater movement is toward areas of lower elevations (Reference 45). Measurements made between December 2002 and September 2003 in observation wells at the site exhibit water level elevations ranging from about Elevation 241 ft msl to Elevation 312 ft msl, with corresponding ground surface elevations of about Elevation 283 and Elevation 335 ft msl, respectively (Table 2.4-15). The measurements shown in Table 2.4-15 represent four quarterly rounds of groundwater level measurements taken at the ESP site to characterize seasonal variability in the water levels. Figure 2.4-15 presents hydrographs based on the water levels provided in this table for the nine observation wells (OW-841 through OW-849) installed as part of the ESP

subsurface investigation program. The other wells that were monitored (P- and WP-) were installed previously for NAPS groundwater monitoring purposes around the SWR and the ISFSI, respectively.

The 5th paragraph of SSAR Section 2.4.12.3 will be revised to read as follows:

> Because the existing units groundwater monitoring wells were not considered to be of sufficient areal extent to determine groundwater levels beneath the ESP site, 9 additional observation wells were installed as part of the ESP subsurface investigation program. Water levels in these 9 wells and 10 of the existing units' monitoring wells were measured quarterly for one year to provide data on groundwater flow direction, gradient, and seasonal groundwater level fluctuations at the site.

The 2nd paragraph of SSAR Section 2.4.12.4 will be revised to read as follows:

> One groundwater observation well (OW-844) was constructed at the existing plant grade as part of the ESP subsurface investigation program (Appendix 2.5.4 B). The well is located near the toe of the slope north of the SWR (Figure 2.4-16). A second well (OW-841) was constructed in the partially backfilled excavation for abandoned Units 3 and 4. The top of this well is about 20 feet below the plant grade. Maximum measured groundwater level elevations in these wells ranged from about Elevation 250 feet in OW-841 to Elevation 267 feet in OW-844 between December 2002 and September 2003 (Table 2.4-15). Considering the general conformance of the location of OW-844 with the water table profile discussed above, these groundwater levels and the piezometric head contours shown on Figure 2.4-16 appear to support the design groundwater level determined for the existing units as described above.

SSAR Table 2.4-15 and Figure 2.4-15 will be replaced with the revised versions shown on the next 2 pages.

Table 2.4-15 Quarterly Groundwater Level Elevations

Observation Well No.	Well Depth* (ft)	Reference Point Elev. (ft)	Reference Point Stickup** (ft)	Top of Well Screen Elev. (ft)	Well Screen Length (ft)	Groundwater Level Elevations Date of Measurement 12/17/02	03/17/03	06/17/03	09/29/03
OW-841	34.3	251.6	1.5	228.1	9.7	248.9	249.6	249.6	249.3
OW-842	49.6	336.7	1.5	297.8	9.6	307.5	308.9	310.8	312.0
OW-843	49.2	320.6	1.5	282.1	9.7	285.1	288.1	290.8	290.2
OW-844	24.6	273.5	1.5	257.6	9.6	265.5	266.7	267.3	266.4
OW-845	55.0	297.3	1.5	253.0	9.7	272.7	274.9	277.4	277.3
OW-846	32.7	297.3	1.5	273.5	9.8	272.5	274.8	277.1	277.0
OW-847	49.8	319.7	1.5	280.6	9.6	285.4	287.0	289.5	290.8
OW-848	47.3	284.5	1.5	240.8	5.0	241.7	242.9	243.6	244.0
OW-849	49.8	298.5	1.5	259.4	9.7	265.5	269.5	271.7	270.8
P-10	22.5	286.4	2.4	267.0	5	274.4	274.8	275.2	275.2
P-14	N/A	327.1	N/A	N/A	N/A	271.6	272.2	272.8	273.1
P-18	N/A	329.0	N/A	N/A	N/A	285.7	286.5	287.5	288.4
P-19	58.5	322.3	N/A	N/A	5	284.3	285.2	286.3	287.3
P-20	61.0	320.6	N/A	N/A	5	274.9	275.4	275.8	275.0
P-21	58.5	319.2	N/A	N/A	5	Dry	261.2	262.0	262.4
P-22	60.0	320.5	N/A	N/A	5	276.8	277.8	278.6	278.9
P-23	41.2	296.4	1.9	258.7	5	261.1	262.6	263.3	263.1
P-24	25.0	293.4	2.3	271.3	5	276.4	277.1	278.4	278.3
WP-3	N/A	317.9(?)	N/A	266.5	5	299.7	301.0	302.8	302.3
Lake Anna Water Level Elevation						248.1	250.1	250.4	250.1
Service Water Reservoir Water Level Elevation						314.6	313.3	314.6	314.6

OW- wells installed in December 2002 as part of ESP Subsurface Investigation Program.

P- wells installed previously to monitor NAPS Units 1 and 2 Service Water Reservoir.

WP- well installed previously as part of Independent Spent Fuel Storage Installation monitoring program.

* Below ground surface at time of installation.

** Above ground surface at time of installation.

N/A - not available

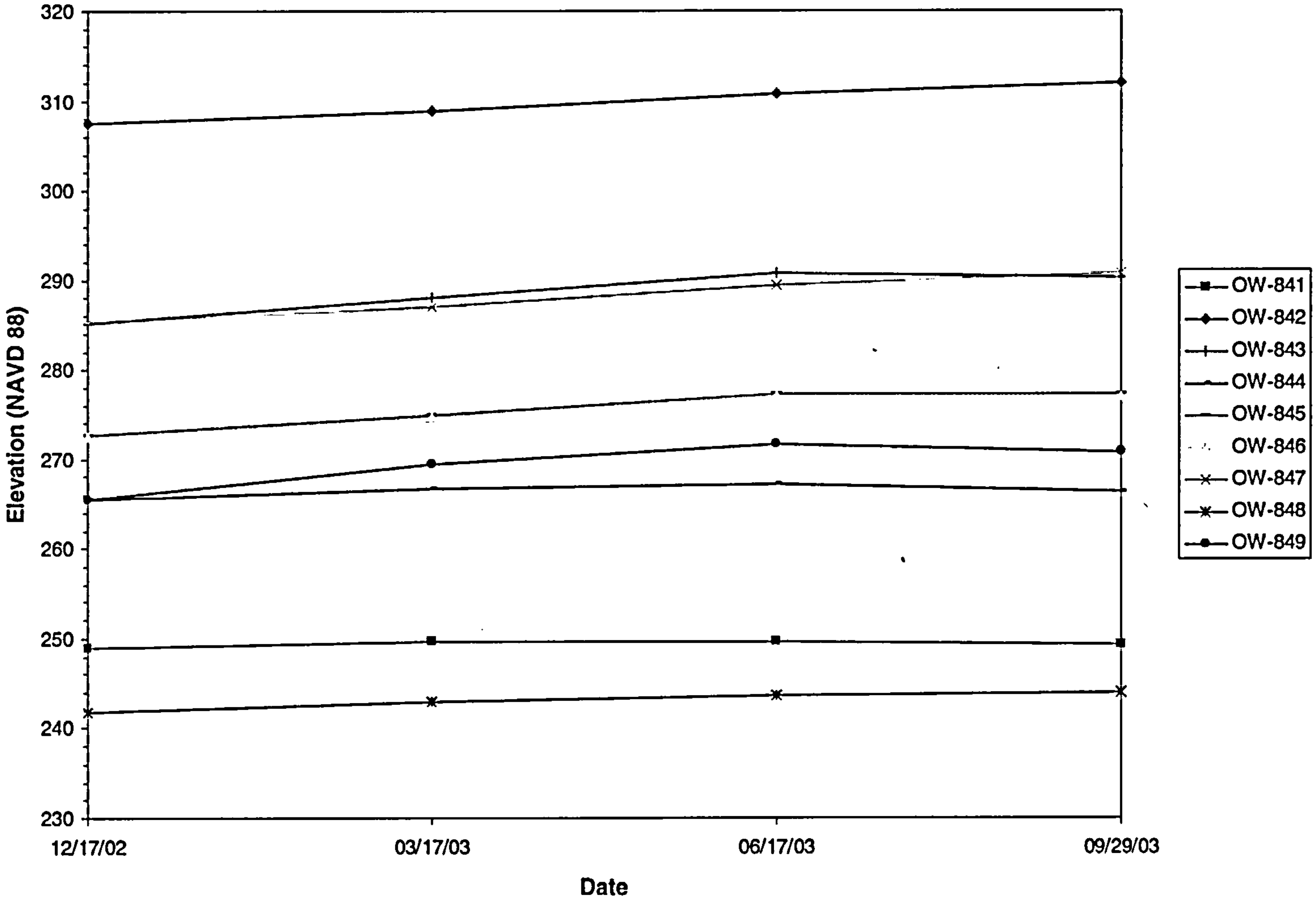


Figure 2.4-15 **Groundwater Level Hydrographs**

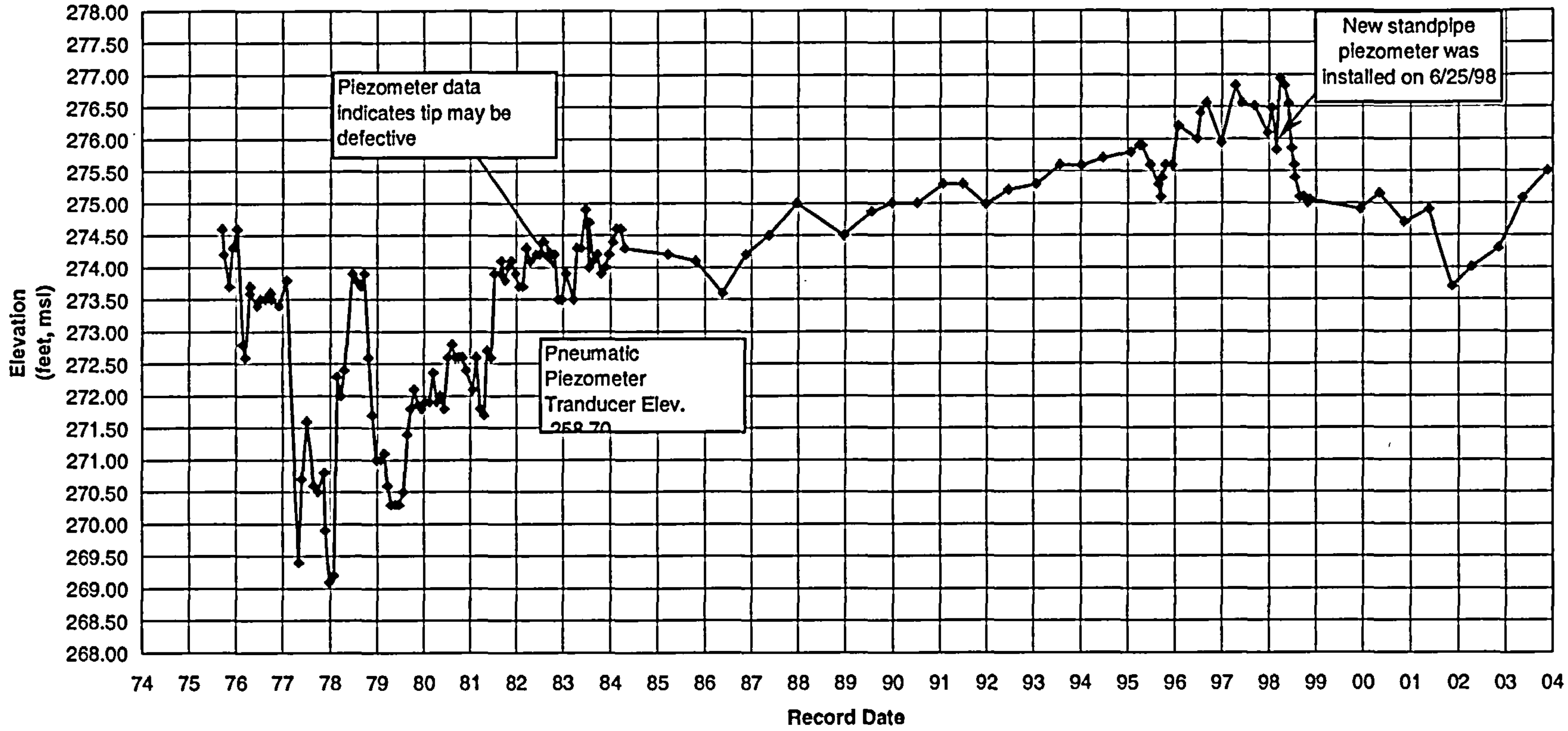
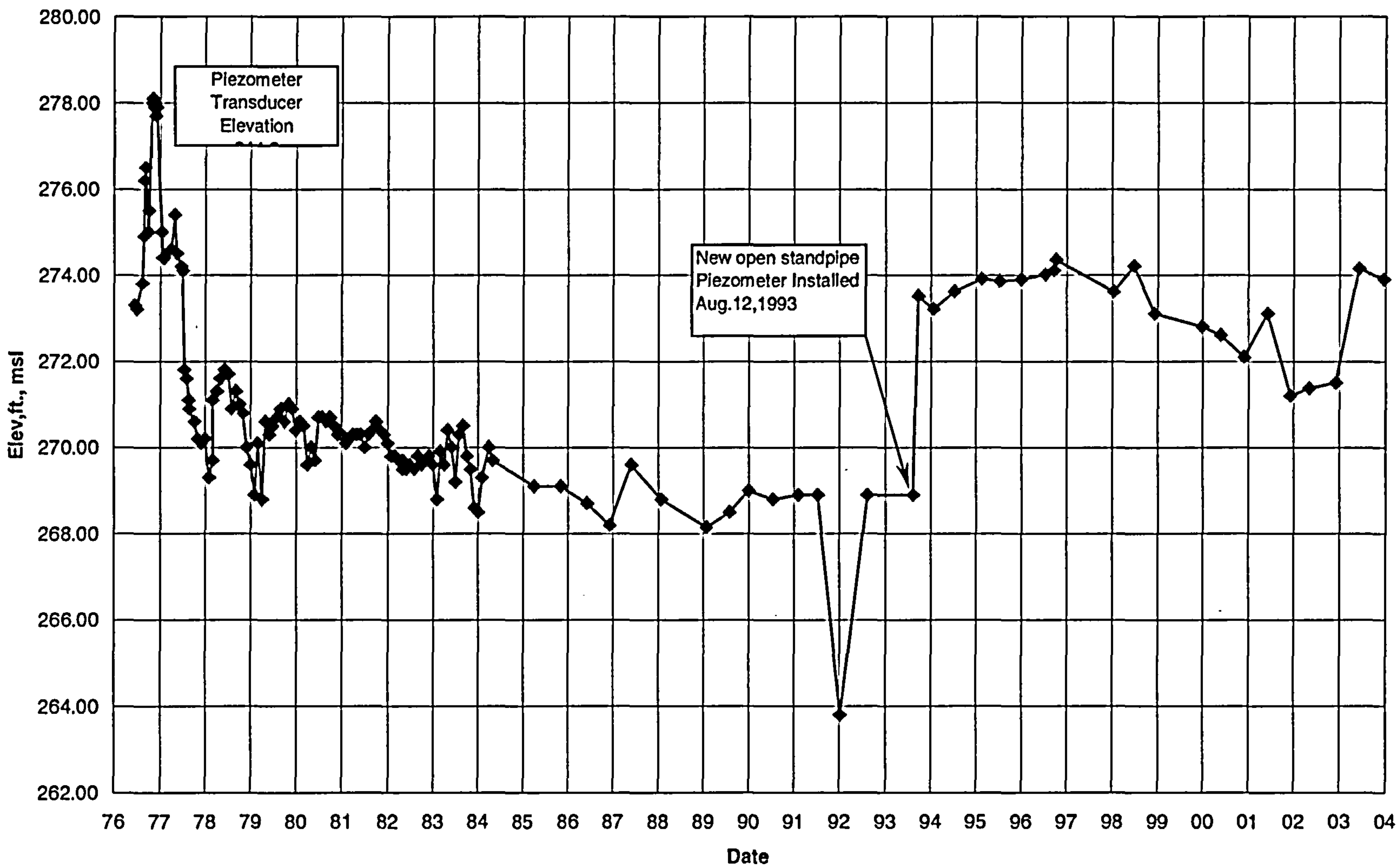


Figure 1. SWR Piezometer P-10

Figure 2. SW R Piezomete r P-14



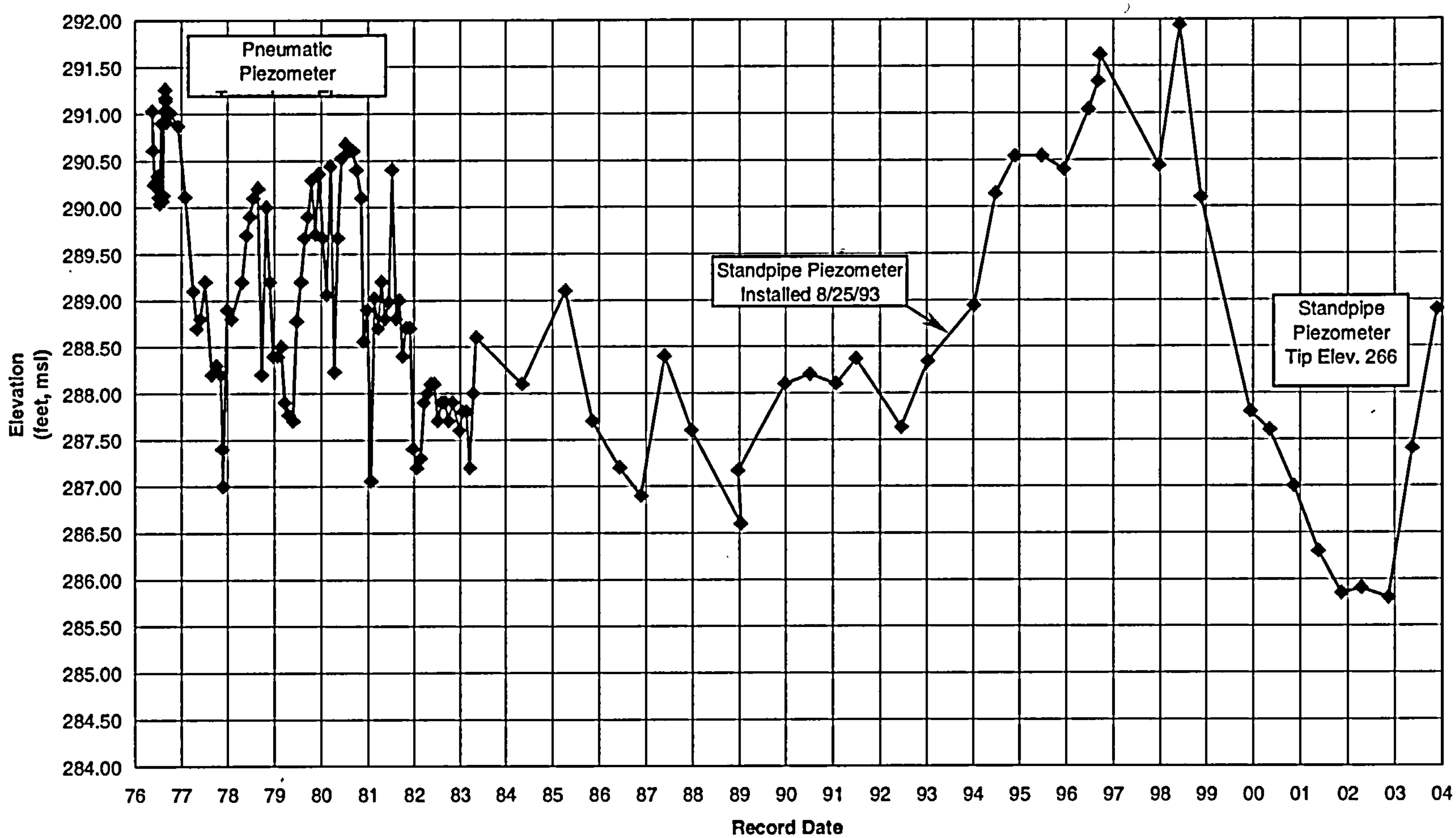


Figure 3. SWR Piezometer P-18

RAI 13.6-1 (NRC 5/12/04 Letter)

Please explain how the ESP plant parameter envelope (PPE) and surrounding terrain features will provide at least 360 feet of distance (specified in Regulatory Guide 4.7, Revision 2, April 1998) between vital equipment/structures and physical protection components (such as protected area barriers and isolation zones). Specifically, please describe the relationship between the PPE as depicted on figure 1.2-4 of the application and the planned protected area for the new facilities.

Response

The planned protected area barrier and related isolation zone would be constructed to comply with the requirements of 10 CFR 73.55(c). The protected area barrier would be separated from vital area barriers as required with sufficient size to support the security response strategy timelines. Isolation zones would be of sufficient size to permit observation of activities of individuals on either side of the protected area barrier. Typically, an isolation zone of twenty feet on each side of the barrier would be maintained.

Application Revision

None.

RAI 17.1-1 (NRC 5/12/04 Letter)

Please describe the quality assurance measures used to authenticate and verify data retrieved from internet websites that supports information in the SSAR that would affect the design, construction, or operation of structures, systems, and components important to safety

Response

Table 1 provides the requested information. Column 4 of the table identifies whether the information from an Internet website reference was used to support information in the SSAR that would affect the design, construction, or operation of structures, systems, and components important to safety. The measures used to authenticate and verify data retrieved from Internet websites that supports information in the SSAR that would affect the design, construction, or operation of structures, systems, and components important to safety are described in Column 5.

Application Revision

None.

Table 1. SSAR Internet Website References

Column 1	Column 2	Column 3	Column 4	Column 5
Number	**Reference**	**How Reference Was Used**	**Does website reference support information in the SSAR that would affect the design, construction, or operation of structures, systems, and components important to safety?**	**If Yes in Column 4, identify methods used to authenticate or verify the data?**
1	Section 2.1, Reference 1. Town of Mineral, Website, www.louisa.net/mineral/, accessed October 14, 2002.	Provides the population of the Town of Mineral.	No. This reference contains general information about a local town only.	Not applicable.
2	Section 2.1, Reference 4. U. S. Department of Commerce, Bureau of the Census, 2000 Census of Population, Website, www.census.gov/main/www/cen2000.html, accessed October 1, 2002.	Provides the population distribution up to 50-mile radius.	No. This reference contains general information about population distribution in the site region.	Not applicable.
3	Section 2.1, Reference 6. Weldon Cooper Center for Public Services, Website. www.ccps.virginia.edu/demographics/estimates/city-co/2001estimates.pdf, accessed September 22, 2003.	Provides the formula for average annual growth of population.	No. This reference contains population projections for the site region that are needed for the duration of the expected plant life.	Not applicable.
4	Section 2.1, Reference 7. Paramount's Kings Dominion, Website, www.kingsdominion.com/visit_calendar.jsp, accessed August 15, 2003.	Provides the number of days per year Kings Dominion is open.	No. This reference contains information that was used only to determine transient population.	Not applicable.
5	Section 2.1, Reference 8. Louisa County High School, website, www.greatschools.net/modperl/browse_school/va/1016, accessed October 11, 2002.	Identifies the schools within 10 miles of the ESP site.	No. This reference contains information that was used only to determine transient population.	Not applicable.

Table 1. SSAR Internet Website References				
Column 1	Column 2	Column 3	Column 4	Column 5
Number	**Reference**	**How Reference Was Used**	**Does website reference support information in the SSAR that would affect the design, construction, or operation of structures, systems, and components important to safety?**	**If Yes in Column 4, identify methods used to authenticate or verify the data?**
6	Section 2.1, Reference 9. Louisa County Middle School, Website, www.greatschools.net/modperl/browse_school/va/1018, accessed October 11, 2002.	Identifies the schools within 10 miles of the ESP site.	No. This reference contains information that was used only to determine transient population.	Not applicable.
7	Section 2.1, Reference 12. Town of Louisa, Virginia, www.louisatown.org/, accessed October 14, 2002.	Provides the population growth for the Town of Louisa.	No. This reference only provides general information about growth of the local town.	Not applicable.
8	Section 2.2, Reference 2. Web Page: Spotsylvania County, Virginia, www. simplyfredericksburg.com/spotsylvania/spotsylvania.shtml.accessed June 27, 2003.	Provides the general location of Spotsylvania county.	No. This reference only provides general information about industrial development and expansion in the county.	Not applicable.
9	Section 2.2, Reference 3. Web page: Louisa County Airport/Freeman Field, Louisa, Virginia, www.airnav.com/airport/LKU/, accessed June 23, 2003.	Provides a description of airport capability (e.g., how many aircraft and number of operations per week).	No. This reference provides general air traffic information only.	Not applicable.

Table 1. SSAR Internet Website References

Column 1	Column 2	Column 3	Column 4	Column 5
Number	Reference	How Reference Was Used	Does website reference support information in the SSAR that would affect the design, construction, or operation of structures, systems, and components important to safety?	If Yes in Column 4, identify methods used to authenticate or verify the data?
10	Section 2.2, Reference 4. Web Page: Lake Anna Airport, Bumpass, Virginia, www.airnav.com/airport/7W4, accessed June 23, 2003.	Provides a description of airport capability (e.g., how many aircraft and number of operations per week)	No. This reference provides general air traffic information only.	Not applicable.
11	Section 2.3, Reference 3. *Storm Events for Virginia, 01/01/1950 Through 12/31/2003*, National Climatic Data Center, NOAA, Website, www4.ncdc.noaa.gov/cgi-win/wwcgi.dll?wwevent~storms, accessed June 2004.	Provides tornado data.	Yes. This reference contains data that were analyzed and used to develop design criteria.	A hard copy of the data that was obtained from the internet was mailed to NCDC with a request to authenticate or verify. Certification of authenticity was received from NCDC.
12	Section 2.3, Reference 7. Virginia Tropical Cyclone Climatology, Website, www.hpc.ncep.noaa.gov/research/roth/vaclimohur.htm, accessed December 12, 2002.	Provides frequency of tropical storms.	No. This reference provides general background information only.	Not applicable.
13	Section 2.3, Reference 20. Virginia Climate Advisory 12/00, Virginia State Climatology Office, Website, www.climate.Virginia.edu/advisory/2000/ad00-12.htm, accessed March 24, 2003.	Identifies date of decommissioning of Partlow 3 WNW cooperative observing station in 1976.	No. This reference provides general background information only.	Not applicable.

Table 1. SSAR Internet Website References				
Column 1	**Column 2**	**Column 3**	**Column 4**	**Column 5**
Number	**Reference**	**How Reference Was Used**	**Does website reference support information in the SSAR that would affect the design, construction, or operation of structures, systems, and components important to safety?**	**If Yes in Column 4, identify methods used to authenticate or verify the data?**
14	Section 2.3, Reference 48 *Storm Events for Virginia (Hail), 1955 through February 2004*, National Climatic Data Center, NOAA, Website,*http://www4.ncdc.noaa.gov/cgi-win/wwcgi.dll?wwevent~storms*, accessed June 25, 2004.	Provides frequency and magnitude of hailstorms.	Yes. This reference contains data that were analyzed and used to develop design criteria.	A hard copy of the data that was obtained from the internet was mailed to NCDC with a request to authenticate or verify. Certification of authenticity was received from NCDC.
15	Section 2.3, Reference 49 *Historical Hurricane Tracks Storm Query, 1851 through 2003*, National Oceanic and Atmospheric Administration Coastal Services Center, Website, *http://hurricane.csc.noaa.gov/hurricanes/index.htm*, accessed June 23 and 25, 2004.	Provides frequency of tropical cyclones within and beyond 100-nautical mile radius of ESP site.	Yes. This reference contains data that were analyzed and used to develop design criteria.	A hard copy of the data that was obtained from the internet was mailed to NOAA-CSC with a request to authenticate or verify. Reply is pending. The website reference would be revised if data is not authenticated or verified.
16	Section 2.4, Reference 2. USGS 01670180 Pamunkey Creek at Lahore, VA, U.S. Geological Survey, 2003. Available at www. Waterdata.usgs.gov/nwis/nwisman/?site_no=01670180&agency_cd=USGS. Accessed February 3, 2003.	Provides stream flow records for 1989 to 1993.	No. This reference contains data that were only used to characterize the mean monthly inflows to Lake Anna from upstream tributaries.	Not applicable.

Table 1. SSAR Internet Website References

Column 1	Column 2	Column 3	Column 4	Column 5
Number	**Reference**	**How Reference Was Used**	**Does website reference support information in the SSAR that would affect the design, construction, or operation of structures, systems, and components important to safety?**	**If Yes in Column 4, identify methods used to authenticate or verify the data?**
17	Section 2.4, Reference 3. USGS 01670300 Contrary Creek near Mineral, VA, U.S. Geological Survey, 2003. Available at www. Waterdata.usgs.gov/nwis/nwisman/?site_no=01670300&agency_cd=USGS. Accessed February 3, 2003.	Provides stream flow records for 1975 to 1987.	No. This reference contains data that were only used to characterize the mean monthly inflows to Lake Anna from upstream tributaries.	Not applicable.
18	Section 2.4, Reference 4. USGS 01671000 North Anna River Near Doswell, VA, U.S. Geological Survey, 2003. Available at www. Waterdata.usgs.gov/nwis/nwisman/?site_no=01671000&agency_cd=USGS. Accessed January 28, 2003.	Identifies drainage area of 441 square miles. Provides stream flow records for 1929 to 1988.	No. This reference contains data that were only used to characterize the mean monthly inflows to Lake Anna from upstream tributaries.	Not applicable.
19	Section 2.4, Reference 5. USGS 01670400 North Anna River Near Partlow, VA, U.S. Geological Survey, 2003. Available at www. Waterdata.usgs.gov/nwis/nwisman/?site_no=01670400&agency_cd=USGS. Accessed January 28, 2003.	Provides record of regulated outflow from Lake Anna. Provides stream flow records for 1978 to 1995.	No. This reference contains data that were only used to characterize mean monthly outflows from Lake Anna.	Not applicable.
20	Section 2.4, Reference 8. Virginia DEQ Water Programs, Water Withdrawal Reporting, Virginia Department of Environmental Quality, October 18, 2002. Available at www.deq.state.va.us/water/waterwith.html.	Provides water use database to locate water intakes that could be adversely affected by accidental release of contaminants.	Yes. This reference contains data that were used to identify surface waters that could be affected by accidental releases of liquid effluents to surface water.	The website database was subsequently received directly from VDEQ by letter.

Table 1. SSAR Internet Website References

Column 1	Column 2	Column 3	Column 4	Column 5
Number	**Reference**	**How Reference Was Used**	**Does website reference support information in the SSAR that would affect the design, construction, or operation of structures, systems, and components important to safety?**	**If Yes in Column 4, identify methods used to authenticate or verify the data?**
21	Section 2.4, Reference 34. Climate of 2002-August Virginia Drought, National Oceanic And Atmospheric Administration, National Climatic Data center, accessed online at lwf.ncdc.noaa.gov/oa/climate/research/2002/aug/st044dv00pcp200208.html, accessed April 22, 2003.	Provides record of driest period in 108-year period for Virginia statewide precipitation.	No. This reference contains data that were only used to characterize the severity of the 2002 drought.	Not applicable.
22	Section 2.4, Reference 35. Climate of 2002-September Virginia Drought, National Oceanic And Atmospheric Administration, National Climatic Data center, accessed online at lwf.ncdc.noaa.gov/oa/climate/research/2002/sep/st044dv00pcp200209.html, accessed April 23, 2003.	Provides record of driest period in 108-year period for Virginia statewide precipitation.	No. This reference contains data that were only used to characterize the severity of the 2002 drought.	Not applicable.
23	Section 2.4, Reference 37. Poff, J.A., A Guide to Virginia's Groundwater, Virginia Water Resources research Center, Virginia Polytechnic Institute and State University, Blacksburg, Virginia, www.vwrrc.vt.edu/publications/publicat.htm, 1999.	Provides description of Virginia's groundwater.	No. This reference provides a general hydrological background description only.	Not applicable.

Table 1. SSAR Internet Website References				
Column 1	**Column 2**	**Column 3**	**Column 4**	**Column 5**
Number	**Reference**	**How Reference Was Used**	**Does website reference support information in the SSAR that would affect the design, construction, or operation of structures, systems, and components important to safety?**	**If Yes in Column 4, identify methods used to authenticate or verify the data?**
24	Section 2.4, Reference 38. Source Water Protection, Designated Sole Source Aquifers in EPA Region III, District of Columbia, Delaware, Maryland, Pennsylvania, Virginia, West Virginia, U.S. Environmental Protection Agency, Region 3, Water Protection Division, www.epa.gov/OGWDW/swp/ssa/reg3.html, November 26, 2002.	Identifies area groundwater source requiring EPA review.	No. This reference provides a general hydrological background description only.	Not applicable.
25	Section 2.4, Reference 39. Status of Virginia's Water Resources, A Report on Virginia's Water Supply Planning Activities, A Report to the Honorable James S. Gilmore III, Governor, and the General Assembly of Virginia, Virginia Department of Environmental Quality, available at www.deq.state.va.us/pdf/gareports/waterresouces2001.pdf, October 2001.	Identifies area southeast of site that has been designated as eastern Virginia Ground Water Management Area by the VDEQ.	No. This reference provides a general hydrological background description only.	Not applicable.
26	Section 2.4, Reference 51. Total Water Withdrawals for Virginia, 1995, U.S. Geological Survey, www.va.water.usgs.giv/w_use/wu_index.htm, January 2, 2003.	Provides USGS national water use estimates, for Virginia, by county or independent city.	No. This reference provides a general hydrological background description only.	Not applicable.

Table 1. SSAR Internet Website References				
Column 1	**Column 2**	**Column 3**	**Column 4**	**Column 5**
Number	**Reference**	**How Reference Was Used**	**Does website reference support information in the SSAR that would affect the design, construction, or operation of structures, systems, and components important to safety?**	**If Yes in Column 4, identify methods used to authenticate or verify the data?**
27	Section 2.4, Reference 58. Safe Drinking Water Information System (SDWIS), Virginia, Louisa County, U.S. Environmental Protection Agency, www.epa.gov/enviro/html/sdwis/sdwis_query.html, April 16, 2003.	Provides water use database to identify groundwater wells that could be adversely affected by an accidental release of liquid effluents.	Yes. This reference contains data that were used to identify groundwater users that could be affected by accidental releases of liquid effluents to groundwater.	A hard copy of the data obtained from the website was mailed to EPA with a request to authenticate or verify. Reply received and is being evaluated. The website reference would be revised if data is not authenticated or verified.
28	Section 2.5, Reference 14. College of William and Mary, The Geology of Virginia: Piedmont Province, Department of Geology Web Source, 1998: www.wm.edu/geology/virginia/piedmont.html.	Characterizes the Piedmont Province as deeply weathered bedrock and a relative paucity of solid rock outcrop.	No. This reference provides general geologic background information only.	Not applicable.
29	Section 2.5, Reference 17. Edwards, J.E., Jr. A Brief Description of the Geology of Maryland, Maryland Geological Survey, Pamphlet Series, Web Source, 1981: www.mgs.md.gov/esic/brochhures/mdgeology.html.	Describes the Continental Shelf Physiographic Province. The shelf extends eastward for about 75 to 80 miles, where sediments reach a maximum thickness of about 40,000 feet.	No. This reference provides general geologic background information only.	Not applicable.

Table 1. SSAR Internet Website References				
Column 1	**Column 2**	**Column 3**	**Column 4**	**Column 5**
Number	**Reference**	**How Reference Was Used**	**Does website reference support information in the SSAR that would affect the design, construction, or operation of structures, systems, and components important to safety?**	**If Yes in Column 4, identify methods used to authenticate or verify the data?**
30	Section 2.5, Reference 20. Bailey, C. M. The Geology of Virginia: Physiographic Map of Virginia, College of William and Mary, department of Geology Web Source, 1999: www.wm.edu/geology/virginia/phys_regions.html.	Describes the Blue Ridge Physiographic Province-South of the border it becomes a mountainous upland with elevations typically ranging from 2400 to 3000 feet and a few peaks rising to elevations of over 5000 feet. Describes the Valley and Ridge Physiographic Province – Elevations within the Valley and Ridges range from about 1000 to 4500 feet.	No. This reference provides general geologic background information only.	Not applicable.

Table 1. SSAR Internet Website References				
Column 1	**Column 2**	**Column 3**	**Column 4**	**Column 5**
Number	**Reference**	**How Reference Was Used**	**Does website reference support information in the SSAR that would affect the design, construction, or operation of structures, systems, and components important to safety?**	**If Yes in Column 4, identify methods used to authenticate or verify the data?**
31	Section 2.5, Reference 23. Fichter, L.S. and S.J. Baedke. The Geologic Evolution of Virginia and the Mid-Atlantic region: Chronology of Events in the Geologic History of Virginia, Stages A through M, James Madison University Web Source, Last Update September 2000: geollab.jmu.edu/vageol/vahist.html	Describes the Regional Geologic History – Greenville Orgeny. In Virginia, the Greenville basement rocks are exposed in the Blue Ridge Province and portions of the Piedmont Province. (Similar discussion for Late Precambrian Extensional; Episode and Taconic Orgeny.)	No. This reference provides general geologic background information only.	Not applicable.

Table 1. SSAR Internet Website References

Column 1	Column 2	Column 3	Column 4	Column 5
Number	**Reference**	**How Reference Was Used**	**Does website reference support information in the SSAR that would affect the design, construction, or operation of structures, systems, and components important to safety?**	**If Yes in Column 4, identify methods used to authenticate or verify the data?**
32	Section 2.5, Reference 30. Fichter, L.S. and S.J. Baedke. The Geologic Evolution of Virginia and the Mid-Atlantic region: A Description of the Geology of Virginia, James Madison University Web Source, Last Update September 2000: gsmres.jmu.edu/geollab/vageol/vahist/PhysProv.html	Describes Regional Stratigraphy; Piedmont Physiographic Province – The first is a set of Late Precambrian and Paleozoic age crystalline rocks and the second is a set of Early Mesozoic (Triassic) age sedimentary rocks deposited locally in down-faulted basins within the crystalline rock. Goochland-Raleigh Belt – rock description Carolina Slate and Eastern Slate Belts – rock description Sedimentary rocks – Early Mesozoic rock discussion	No. This reference provides general geologic background information only.	Not applicable.

Table 1. SSAR Internet Website References

Column 1	Column 2	Column 3	Column 4	Column 5
Number	**Reference**	**How Reference Was Used**	**Does website reference support information in the SSAR that would affect the design, construction, or operation of structures, systems, and components important to safety?**	**If Yes in Column 4, identify methods used to authenticate or verify the data?**
33	Section 2.5, Reference 38. Bailey, C.M. The Geology of Virginia: Generalized geologic Terrane Map of the Virginia Piedmont and Blue Ridge, College of William and Mary, Department of Geology Web Source, 1999: www.wm.edu/geology/virginia/phys_regions.html	Describes Regional Stratigraphy – Charlotte, Milton, and Chopawamsic Belts.	No. This reference provides general geologic background information only.	Not applicable.
34	Section 13.3, Reference 45. Dominion Home Page (www.dom.com)	Supports description of overall Dominion Resources, Inc. (DRI) corporate organization, business, and assets.	No.	Not applicable.
35	Section 2.3.2.5, Reference 58. EPA-OAQPS-PM2.5 Designations.htm "EPA Responds to States and Tribes-Comparison of state and EPA recommendations" (http://www.epa.gov/pmdesignations/documents/120/revisions.pdf), accessed June 2004.	Provide background from EPA regarding attainment designations.	No	Not applicable.