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

Dominion®

January 13, 2006

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

Serial No. 06-010
ESP/JDH
Docket No. 52-008

DOMINION NUCLEAR NORTH ANNA, LLC
NORTH ANNA EARLY SITE PERMIT APPLICATION
SUPPLEMENT TO ADDRESS A MODIFIED APPROACH TO UNIT 3 COOLING AND TO ENSURE THE PLANT PARAMETER ENVELOPE REMAINS BOUNDING

As described in the Dominion Nuclear North Anna, LLC (Dominion) letters dated October 24 and November 22, 2005, Dominion has modified its approach for cooling a potential third unit at the North Anna ESP site. We committed to submit a stand-alone supplement to the North Anna ESP application to address safety and environmental changes in the application resulting from our decision.

On August 24, 2005, GE submitted an application to the NRC for final design approval (FDA) and certification of the ESBWR design. After reviewing the ESBWR design submitted to NRC, we have adjusted the North Anna ESP application PPE to reflect an increased core thermal power value (and corresponding estimated electrical output).

The entire North Anna ESP application (currently Revision 5) has been reviewed. Summary lists of sections/subsections that are affected and those that are not affected are provided in Enclosures 1 and 2, respectively. The ESP supplement is provided in Enclosure 3 and contains the specific information that has changed along with supporting justification. The ESP supplement contains information that would ultimately be incorporated in a future Revision 6 of the North Anna ESP application. The ESP supplement uses the same section/subsection numbering as the application.

If you have any questions, please contact Joe Hegner at 804-273-2770 or Tony Banks at 804-273-2170.

Very truly yours,

Eugene S. Grecheck
Vice President-Nuclear Support Services

D074

Enclosures:
1. List of NAPS ESP Application—Affected Sections
2. List of NAPS ESP Application—Unaffected Sections
3. North Anna ESP Supplement

Commitment made in this letter: None

cc: 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. J. T. Reece
NRC Senior Resident Inspector
North Anna Power Station

Mr. Nitin Patel
U. S. Nuclear Regulatory Commission
Washington, D.C. 20555

Mr. Richard Kingston
GE Nuclear Energy
Castle Hayne Rd, PO Box 780
Wilmington, NC 28401

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

Mr. Adrian Heymer
Nuclear Energy Institute
1776 I Street, N.W., Suite 400
Washington, D.C. 20006-3708

Administrative Judge
Alex S. Karlin, Chair
Atomic Safety and Licensing Board
Mail Stop T-3 F23
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555

Administrative Judge
Dr. Thomas S. Elleman
Atomic Safety and Licensing Board
Mail Stop T-3 F23
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555

Administrative Judge
Dr. Richard F. Cole
Atomic Safety and Licensing Board
Mail Stop T-3 F23
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555

Dianne Curran, Esq.
Harmon, Curran, Spielberg & Eisenberg, LLP
1726 M Street, N.W., Suite 600
Washington, D.C. 20036

Richard A. Parrish, Esq.
Southern Environmental Law Center
201 West Main Street
Charlottesville, VA 22902

Morgan W. Butler, Esq.
Southern Environmental Law Center
201 West Main Street
Charlottesville, VA 22902

Robert M. Weisman, Esq.
Office of General Counsel
U.S. Nuclear Regulatory Commission

Michael A. Woods, Esq.
Office of General Counsel
U.S. Nuclear Regulatory Commission

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 13th day of January, 2006.

My Commission expires: My Commission Expires July 31, 2007

Vera L. Thana
Notary Public

(SEAL)

Enclosure 1

North Anna ESP Application

Sections Affected by the Supplement

North Anna ESP Application -- Affected Sections

Revised Cooling Approach

After conducting additional evaluations of cooling water alternatives, Dominion decided to utilize a closed-cycle, combination wet and dry cooling tower approach instead of the once-through cooling system originally proposed. Cooling water from the secondary (steam) system would flow through both dry and wet cooling towers in sequence. No water loss would occur in the dry cooling towers, while the wet towers would incorporate water saving features to limit evaporative water loss. Make-up water (due to the evaporative loss) would come from the North Anna Reservoir, while blowdown from the wet towers would be discharged to the Waste Heat Treatment Facility (WHTF).

The proposed Unit 3 cooling system would operate under two modes:

1. Energy Conservation (EC) – Dry cooling is reduced, with reliance mostly on wet towers for heat removal.
2. Maximum Water Conservation (MWC) – A minimum of one-third of the heat is removed by the dry towers, with the remainder removed by the wet towers.

When the North Anna Reservoir level is at or above 250 ft msl (mean sea level) and adequate reservoir discharge is being maintained, the EC mode would be used. If the reservoir level falls to below 250 ft msl and is not restored within a reasonable period of time, e.g. seven days, the MWC mode would be used.

This revised approach for Unit 3 cooling would reduce both the thermal impacts and water consumption associated with Lake Anna. As noted in previous correspondence, the company is taking this action partly in response to concerns raised by state regulatory bodies and local residents. While the supplement was being prepared, Dominion met with appropriate state agencies including the Commonwealth of Virginia's Departments of Environmental Quality and Game and Inland Fisheries. On those occasions we described the cooling water system conceptual design capability and addressed the thermal impact and water consumption concerns raised with the intent of establishing a basis for reasonable assurance of obtaining those agencies' concurrence.

The Unit 4 dry cooling approach presented in the ESP Application is unchanged.

Changes Based on August 24, 2005 ESBWR Design

Preliminary ESBWR design information used in developing the North Anna ESP application plant parameter envelope (PPE) reflected the design based on the best available information at the time the application was submitted to NRC in September 2003. Approximately two years later, on August 24, 2005, GE submitted an application to the NRC for final design approval (FDA) and certification of the ESBWR design. After reviewing the ESBWR design submitted to NRC, we have adjusted the North Anna ESP application PPE to reflect an increased core thermal power value (and corresponding estimated electrical output) as well as certain application sections to reflect revised accident analyses results due to the increased core thermal power.

Affected Section/Subsection List

Sections are identified at the first logical break between affected and unaffected sections/subsections.

SSAR Chapter 1 – Introduction and General Description

SSAR 1.2.2 - Site Development

SSAR 1.3 - Plant Parameters Envelope

SSAR 1.9 - Site Characteristics and Design Parameters

SSAR Chapter 2 – Environmental Description

SSAR 2.3.2 - Local Meteorology

SSAR 2.4.1 - Hydrologic Description

SSAR 2.4.4 - Potential Dam Failures

SSAR 2.4.7 - Ice Effects

SSAR 2.4.8 - Cooling Water Canals and Reservoirs

SSAR 2.4.10 - Flooding Protection Requirements

SSAR 2.4.11 - Low Water Considerations

SSAR Chapter 15 – Accident Analyses

SSAR 15.3 - Source Terms

SSAR 15.4 - Radiological Consequences

ER Chapter 1 – Introduction

ER 1.1.3 - Reactor Information

ER 1.1.4 - Cooling System Information

ER Chapter 2 – Environmental Description

ER 2.3.1 - Hydrology

ER 2.3.3 - Water Quality

ER 2.4.1 - Terrestrial Ecology

ER Chapter 3 – Plant Description

ER 3.1.2 - Power Plant Design

ER 3.1.3 - Plant Parameters Envelope

ER 3.1.5 - Site Development and Improvements

ER 3.1.6 - Site Characteristics and Design Parameters

ER 3.2 – Reactor Power Conversion System

ER 3.2.1 - Reactor Description

ER 3.2.3 - Power Conversion Systems

ER 3.3 - Plant Water Use

ER 3.4 - Cooling System

ER 3.6.1 - Effluents Containing Chemicals or Biocides

ER 3.7 - Power Transmission System

ER 3.8.1 - Light-Water-Cooled Reactors [transportation of radioactive materials]

ER Chapter 4 – Environmental Impacts of Construction

ER 4.1.1 - The Site and Vicinity [land-use impacts]

ER 4.2.1 - Hydrologic Alterations

ER 4.3.1 - Terrestrial Ecosystems

ER 4.3.2 - Aquatic Ecosystems

ER Chapter 5 – Environmental Impacts of Station Operation

ER 5.1.1 - The Site and Vicinity

ER 5.2 - Water-Related Impacts

ER 5.3 - Cooling System Impacts

ER 5.4.2 - Radiation Doses to Members of Public

ER 5.4.3 - Impacts to Members of Public [operational radiation impacts]

ER 5.5.1 - Nonradioactive-Waste-System Impacts

ER 5.7.1 - Light-Water-Cooled Reactors [Uranium fuel cycle impacts]

ER 5.8.1 - Physical Impacts of Station Operation [Socioeconomic]

ER 5.10 - Measures and Controls to Limit Adverse Impacts During Operation

ER Chapter 6 – Environmental Measurements and Monitoring Programs

ER 6.1.2 - Pre-Application, Pre-Operational, and Operational Thermal Monitoring

ER 6.3.2 - Construction and Pre-Operational Monitoring [hydrological]

ER 6.5.2 - Aquatic Ecology [monitoring]

ER Chapter 7 – Environmental Impacts of Postulated Accidents Involving Radioactive Materials

ER 7.1.3 - *Source Terms* [design basis]

ER 7.1.4 - Radiological Consequences [design basis]

ER Chapter 9 – Alternatives to the Proposed Action

ER 9.4.1 - Heat Dissipation Systems

ER 9.4.2 - Circulating Water Systems

ER 10 – Environmental Consequences of the Proposed Action

ER 10.1 – Unavoidable Adverse Environmental Impacts

ER 10.2 – Irreversible and Irretrievable Commitments of Resources

ER 10.3 – Relationship Between Short-Term Uses and Long-Term Productivity of the Human Environment

Enclosure 2

North Anna ESP Application

Sections Unaffected by the Supplement

North Anna ESP Application -- Unaffected Sections

The entire North Anna ESP application has been reviewed. No changes to the sections/subsections listed below are required as a result of Dominion's decision to modify its cooling approach for Unit 3, or to ensure that the PPE remains bounding. The sections listed below remain in effect. The sections are identified at the first logical break between affected and unaffected sections/subsections.

SSAR Chapter 1 – Introduction and General Description

SSAR 1.1 - Introduction

SSAR 1.2.1 - Site Location

SSAR 1.4 - Identification of Agents and Contractors

SSAR 1.5 - Requirements for Further Technical Information

SSAR 1.6 - Material Incorporated by Reference

SSAR 1.7 - Drawings and Other Detailed Information

SSAR 1.8 - Conformance to NRC Regulations and Regulatory Guidance

SSAR Chapter 2 – Site Characteristics

SSAR 2.1 - Introduction

SSAR 2.2 - Nearby Industrial, Transportation, Military Facilities

SSAR 2.3.1 - Regional Climatology

SSAR 2.3.3 - Onsite Meteorological Measurements Program

SSAR 2.3.4 - Short-Term (Accident) Diffusion Estimates

SSAR 2.3.5 - Long-Term (Routine) Diffusion Estimates

SSAR 2.4.2 - Floods

SSAR 2.4.3 - Probable Maximum Flood on Streams and Rivers

SSAR 2.4.5 - Probable Maximum Surge and Seiche Flooding

SSAR 2.4.6 - Probable Maximum Tsunami Flooding

SSAR 2.4.9 - Channel Diversions

SSAR 2.4.12 - Groundwater

SSAR 2.4.13 - Accidental Releases of Liquid Effluents to Ground and Surface Waters

SSAR 2.5 - Geology, Seismology, and Geotechnical Engineering

SSAR Chapter 3 – Design of Structures, Components, Equipment, and Systems

SSAR Chapter 13 – Conduct of Operations

SSAR Chapter 15 – Accident Analysis

SSAR 15.1 - Selection of Accidents

SSAR 15.2 - Evaluation Methodology

SSAR Chapter 17 – Quality Assurance

ER Chapter 1 – Introduction

ER 1.1.1 - The Applicant and Owner

ER 1.1.2 - Site Location

ER 1.1.5 - Transmission System Information

ER 1.1.6 - Pre-Application Public Involvement

ER 1.1.7 - Construction Start Date

ER 1.2 - Status of Reviews, Approvals, and Consultations

ER Chapter 2 – Environmental Description

ER 2.1 - Site Location

ER 2.2 - Land

ER 2.3.2 - Water Use

ER 2.4.2 - Aquatic Ecology

ER 2.5 - Socioeconomics

ER 2.6 - Geology

ER 2.7 - Meteorology and Air Quality

ER 2.8 - Related Federal Project Activities

ER Chapter 3 – Plant Description

ER 3.1.1 - Existing Site Development

ER 3.1.4 - Plant Appearance

ER 3.2.2 - Engineered Safety Features

ER 3.5 - Radioactive Waste Management System

ER 3.6.2 - Sanitary System Effluents

ER 3.6.3 - Other Effluents

ER 3.8.2 - Gas-Cooled Reactors [transportation of radioactive materials]

ER 3.8.3 - Methodology Assessment [transportation of radioactive materials]

ER Chapter 4 – Environmental Impacts of Construction

ER 4.1.2 - Transmission Corridors and Offsite Areas

ER 4.1.3 - Historic Properties and Cultural Resources

ER 4.2.2 - Water-Use Impacts

ER 4.2.3 - Future Growth and Development Impacts

ER 4.4 - Socioeconomic Impacts

ER 4.5 - Radiation Exposure to Construction Workers

ER 4.6 – Measures and Controls to Limit Adverse Impacts During Construction

ER Chapter 5 – Environmental Impacts of Station Operation

ER 5.1.2 - Transmission Corridors and Offsite Areas

ER 5.1.3 - Historic Properties

ER 5.4.1 - Exposure Pathways [radiological]

ER 5.4.4 - Impacts to Biota Other than Members of the Public [radiological]

ER 5.5.2 - Mixed Waste Impacts

ER 5.5.3 - Conclusions [environmental impacts of waste]

ER 5.6 - Transmission System Impacts

ER 5.7.2 - Gas-cooled Reactors [Uranium fuel cycle impacts]

ER 5.7.3 - Methodology Assessment [Uranium fuel cycle impacts]

ER 5.8.2 - Social and Economic Impacts of Station Operation

ER 5.8.3 - Environmental Justice Impacts

ER 5.9 - Decommissioning

ER Chapter 6 – Environmental Measurements and Monitoring Programs

ER 6.1.1 - Existing Thermal Monitoring Program

ER 6.2 - Radiological Monitoring

ER 6.3.1 - Existing Hydrological Monitoring

ER 6.3.3 - Operational Monitoring [hydrological]

ER 6.4 - Meteorological Monitoring

ER 6.5.1 - Terrestrial Ecology and Land Use

ER 6.6 - Chemical Monitoring

ER 6.7 - Summary of Monitoring Programs

ER Chapter 7 – Environmental Impacts of Postulated Accidents Involving Radioactive Materials

ER 7.1.1 - Selection of Accidents [design basis]

ER 7.1.2 - Evaluation Methodology [design basis]

ER 7.2 - Severe Accidents

ER 7.3 - Severe Accident Mitigation Alternatives

ER 7.4 - Transportation Accidents

ER Chapter 8 – Need for Power

ER Chapter 9 – Alternatives to the Proposed Action

ER 9.1 - No-Action Alternative

ER 9.2 - Energy Alternatives

ER 9.3 - Alternative Sites

ER 9.4.3 - Transmission Systems

Enclosure 3

North Anna ESP Supplement

SSAR Section 1.2.2, Site Development. This section is revised to reflect the bounding ESBWR power level of 4500 MWth. The 3rd paragraph of SSAR Section 1.2.2 will be revised to read as follows:

No specific plant design has been chosen for the ESP site within the NAPS site. Instead, a set of bounding plant parameters is presented to envelop future ESP site development. This PPE is based on the addition of power generation from two distinct units, to be designated North Anna Units 3 and 4. (The PPE is described in Section 1.3.) Each unit represents a portion of the total generation capacity to be added and would consist of one or more reactors or reactor modules. These multiple reactors or modules (the number of which may vary depending on the reactor type selected) would be grouped into distinct operating units. Each unit would consist of a plant of one or more modules that would not exceed 4500 MWth of nuclear generating capacity. Because a specific design has not been selected, boundaries have been established for the placement of the new units. The boundaries are shown in Figure 1.2-4.

SSAR Section 1.3.2.4, Economic Simplified Boiling Water Reactor. This section is revised to reflect the maximum ESBWR power level of 4500 MWth (1520 MWe). The 1st paragraph of SSAR Section 1.3.2.4 will be revised to read as follows:

The ESBWR is a further evolution from the ABWR and is designed by the General Electric Company. The ESBWR is a 4500 MWth single cycle BWR with an estimated electrical output of 1520 MWe. The ESBWR relies on the use of natural circulation and passive safety features to enhance plant performance and simplify the design. The use of natural circulation has allowed the elimination of several BWR systems. This has also increased plant accident reliability by eliminating active safety systems for emergency plant cooling.

SSAR Table 1.3-1, Plant Parameters Envelope. This table is revised to reflect changes to the PPE as a result of ESBWR design power level increase and change in method of cooling. PPE Sections 2.2.1, 2.2.2, 2.5.5, 15.1.1, and 16.3 of SSAR Table 1.3-1 will be revised to read as follows:

[See following page]

Table1.3-1 Plant Parameters Envelope

PPE Section		Bounding Value [Value for 2 Units in brackets]	Bound Notes See Table 1.3-2	Comments	Definition
2.2.1	Max Inlet Temp Condenser/ Heat Exchanger	100°F [Same for 2nd unit/group.]	2,3,4		Design assumption for the maximum acceptable circulating water temperature at the inlet to the condenser or cooling water system heat exchangers.
2.2.2	Condenser / Heat Exchanger Duty	1.03 E10 btu/hr [Additional 1.03 E10 btu/hr for 2nd unit/group]	11		Design value for the waste heat rejected to the circulating water and service water systems.
2.5.5	Heat Rejection Rate	1.03 E10 Btu/hr [2.06 E10 Btu/hr]	11		The expected heat rejection rate.
15.1.1	Diesel Capacity	2 x 15,000 kw [4 x 15,000 kw]	11		The capacity of diesel engines used for generation of standby electrical power.
16.3	Megawatts Thermal	4500 MWt [9000 MWt]	11		The thermal power generated by one unit (may be the total of several modules).

SSAR Table 1.9-1, ESP Site Characteristics and Design Parameters. This table is revised to reflect the use of cooling towers in lieu of once-through cooling and the increase in ESBWR design power level. SSAR Table 1.9-1, Items "Cooling Water Intake Structure Ice Formation", "Normal Plant Heat Sink," and "Plant Characteristics," will be revised to read as follows:

Table 1.9-1 ESP Site Characteristics and Design Parameters

Item	Single Unit/Group Value [Second Unit/Group Value]	Description and References
Part 1 - Site Characteristics		
Intake Structure Ice Formation	Potential for formation of frazil and anchor ice [Same for 2nd unit/group]	• Refer to Section 2.4.7.4
Part 2 - Design Parameters		
Normal Plant Heat Sink		• Item 2 of Table 1.3-1
• Unit 3 Closed-cycle, Dry and Wet Tower Cooling		• Item 2.3 of Table 1.3-1
Make-up Flow Rate	22,269 gpm, maximum (EC mode)	• Maximum rate of removal of water from Lake Anna to replace water losses from the closed-cycle cooling water system. • Item 2.3.9 of Table 1.3-1 • Refer to Sections 2.4.1.1 and 2.4.8.
Blowdown Flow Rate	5565 gpm, maximum (EC mode)	• Maximum flow rate of the blowdown stream from the closed cooling water system to Lake Anna. • Item 2.3.4 of Table 1.3-1 • Refer to Sections 2.4.1.1 and 2.4.8.
Plant Characteristics		• Item 16 of Table 1.3-1
• Megawatts Thermal	≤ 4500 MWt [≤ 9000 MWt]	• The thermal power generated by one unit (may be the total of several modules). • Item 16.3 of Table 1.3-1 • Refer to Sections 1.2.2, 1.3.2.4, 15.3 & 15.4.

SSAR Section 2.3.2.3, Potential Influence of the Plant and the Facilities on Local Meteorology. This section is revised to reflect the minimal impacts on lake temperature, fog formation, and ambient air temperature resulting from Unit 3 cooling tower operation. The 3rd paragraph of SSAR Section 2.3.2.3 will be replaced with the following two new paragraphs:

As discussed in Part 3: Section 5.3.2.1.2, the increase in maximum daily surface water temperature on the Lake resulting from operation of the Unit 3 cooling system would be negligible and would not impact the ongoing moderation of temperature extremes and alterations of wind patterns by the lake. Under extreme humidity conditions during cooler seasons, the increase in cooling lake induced-fog formation resulting from the operation of Unit 3 and Unit 4 would be negligible.

The convective and conductive heat losses to the atmosphere resulting from the operation of the Unit 3 closed-cycle dry and wet cooling tower system would dissipate rapidly through continuous mixing and entrainment with the surrounding moving air mass. Therefore, any increase in overall ambient temperature would be very localized to the NAPS site and would not affect the ambient atmospheric and ground temperature beyond the NAPS site.

SSAR Section 2.4.1.1, Site and Facilities. This section is revised to reflect the use of a closed-cycle, dry and wet cooling tower system for proposed Unit 3 and to identify the make-up water and blowdown discharge flowrates. The 3rd and 4th paragraphs of SSAR Section 2.4.1.1 will be revised to read as follows:

New Unit 3 would use a closed-cycle, dry and wet cooling tower system for the circulating water system. A separate, service water cooling system would utilize a closed-cycle, wet cooling tower for dissipation of waste heat from auxiliary heat exchangers not cooled by the plant circulating water system. Make-up water for the wet cooling towers would be supplied from the North Anna Reservoir at a maximum instantaneous rate of 49.6 cubic feet per second (cfs). Blowdown discharge from the wet cooling towers would be returned to the reservoir at a maximum instantaneous rate of 12.4 cfs via the WHTF.

New Unit 4 would use a closed-cycle cooling system with dry cooling towers in which the exhaust from the plant's steam turbines would be directed to a surface condenser where the heat of vaporization would be rejected to a closed loop of cooling water. The heated cooling water would be circulated to the finned tubes of the dry cooling towers where heat content of the cooling water would be transferred to the ambient air. To increase heat rejection to the atmosphere, electric motor driven fans would be used to force airflow across the finned tubes. After passing through the cooling towers, the cooled water would be recirculated back to the surface condenser to complete the closed-cycle cooling water loop. Except for the initial filling of the cooling water loop, Unit 4 would have no make-up water need since dry tower systems typically have no evaporative water losses and would have no continuous blowdown discharge to the WHTF. In the event that the cooling water loop used an open pump sump configuration with a free surface, a small amount of evaporation losses, estimated to be about 1 gpm (0.002 cfs), will occur. Any make-up water necessary to replenish the small evaporative losses for Unit 4, would be obtained from the North Anna Reservoir. The plant service water cooling system for Unit 4 would use dry cooling towers, which would have minimal to no make-up water requirements.

SSAR Section 2.4.4, Potential Dam Failures. This section is revised to describe the make-up water source for the proposed Unit 3 dry and wet cooling towers. The 2nd paragraph of SSAR Section 2.4.4 will be revised to read as follows:

Lake Anna would serve as the make-up water source for the wet cooling towers proposed for Unit 3. These include the wet cooling towers used for the circulating water system and the wet cooling towers used for service water cooling. As described in Section 2.4.11.6, the ultimate heat sink (UHS) would consist of a mechanical draft cooling tower over a buried water storage basin or other passive water storage facility as required by the reactor design. The UHS facilities would provide a source of water for the service water system in the event that the primary source becomes unavailable. Therefore, adequate service water would be immediately available to maintain any new unit or units in a safe condition, even if Lake Anna were to be drained due to a dam failure. No safety-related structures or systems of any new units would be adversely affected by the loss of water in Lake Anna due to dam failure.

SSAR Section 2.4.7.2, Description of the Cooling Water System. This section is revised to reflect the use of a closed-cycle, dry and wet cooling tower system for proposed Unit 3 and to describe the make-up and blowdown water source and discharge points. The 2nd and 3rd paragraphs of SSAR Section 2.4.7.2 will be revised to read as follows:

For the new units, Unit 3 would use a closed-cycle, dry and wet cooling tower system for the main condenser. Make-up water for the wet cooling towers would be supplied from the North Anna Reservoir. Blowdown discharge from the wet cooling towers would be returned to the reservoir via the WHTF. Unit 4 would use a closed-cycle cooling system and dry towers, which would typically have no evaporative losses. In the event that the secondary cooling water loop of the selected dry tower system incorporates a pump sump with a free water surface, a small amount of evaporation will occur. The evaporation from this surface has been estimated to be about 1 gpm (0.002 cfs). Any Unit 4 make-up water would be provided from the reservoir through separate pumps located inside a new pump intake structure. The plant service water cooling system for Unit 3 would use wet cooling towers. Make-up water for these wet cooling towers would be supplied from the North Anna Reservoir via make-up water pumps or other water supply pumps located in the new pump intake structure. The service water cooling tower blowdown discharge would be discharged to the WHTF and returned to the North Anna Reservoir. Dry cooling towers would be used to cool plant service water for Unit 4. The emergency cooling water for both Units 3 and 4 would be provided from a separate underground concrete storage basin covered by cooling towers to dissipate the rejected heat from the reactor during emergency conditions or from a passive water storage facility.

The cooling designs for Units 3 and 4 separate the normal cooling and the emergency cooling water systems. The discussion and analysis presented in this section demonstrates that the normal closed-cycle, dry and wet cooling tower (Unit 3) and closed-cycle, dry cooling tower (Unit 4) systems are reliable and would not be affected by the ice conditions in the lake. Furthermore, the section includes data analysis and discussion of the effect of combined snow and winter PMP on safety-related structures.

SSAR Section 2.4.7.4, Frazil Ice. This section is revised to reflect the use of a closed-cycle, dry and wet cooling tower system for proposed Unit 3. References to additional heat added to Lake Anna from the new units have been deleted. The 4th and 5th paragraphs of SSAR Section 2.4.7.4 will be revised to read as follows:

The data presented in Table 2.4-12, obtained by Virginia Power as part of their thermal monitoring program, show the number of days during which the intake water temperature fell below 4°C (39.2°F). These data indicate that the water temperature at the intake during the winter months has historically been above freezing. Thus, even in the presence of surface turbulence generated by winds, frazil ice would not form due to high surface temperature. With the operation of the existing units, frazil ice would not be expected to form at the intakes of the new units.

If, for some reason, Units 1 and 2 do not operate for a prolonged period in the winter, the lake water temperature would eventually decrease at a rate dependent on the prevailing air temperature and wind. Under these conditions super cooling could lead to the formation of frazil ice. However, for frazil ice to form, sufficient turbulence is required. The design of the new intake would be such that approach velocities would be 1 foot per second or less. This low flow would not produce sufficient turbulence to generate frazil ice, based on criteria stated in Reference 27 and others. Turbulence also can be generated by strong and sustained wind over the lake during the same climatic conditions. Even though historical wind data at Richmond, Virginia (Reference 24) do not show the occurrence of such events, it is possible that such winds could develop over an open water body such as Lake Anna. If extreme events were to occur during a period when Units 1 and 2 are not operating, it is possible that frazil ice could form in the intake area. In the event that it does, safety-related facilities would not be adversely affected. The UHS would provide a source of cooling and service water, if needed, to maintain the plant in a safe mode should the North Anna Reservoir intake become inoperable due to frazil ice formation. Further information on the UHS is found in Section 2.4.11.

SSAR Section 2.4.7.5, Surface Ice. This section is revised to reflect the use of a closed-cycle, dry and wet cooling tower system for proposed Unit 3. References to additional heat added to Lake Anna from the new units have been deleted. The 3rd, 4th, and 5th paragraphs of SSAR Section 2.4.7.5 will be revised to read as follows:

However, if the existing units were off-line during a relatively sustained freezing weather period, the formation of surface ice is possible, based on examination of the mean daily air temperature for the 1961–1995 time period. The data show that there were several years in which the mean daily temperature in the December through March time frame was below freezing for one to three weeks.

The maximum ice thickness that could have formed under historic low air temperatures with no units in service has been predicted. The meteorological data for the Piedmont Research Station (Reference 61) have been analyzed to determine the degree-days below freezing. In the December 1976 through March 1977 period, there were about 322 cumulative degree-days below freezing. Using this information and employing Assur's method as presented in Chow (Reference 29) (Reference 30), the calculated ice thickness is approximately 17.1 inches. This ice layer would not impact water flow upon restart due to the water depth at the new intakes (a minimum of approximately 10 feet). Instead, this surface ice layer would insulate and provide protection against the formation of frazil ice. However, the formation of surface ice can exert a high load on the intake structure wall in contact with the water. Ice forces would be accounted for in the design of the intake and described in the COL application. It should also be noted that the intakes and associated pumps for the new units would not be safety-related facilities. Emergency cooling and service water needed to maintain the new units in a safe mode would be supplied by a separate UHS. Therefore, no safety-related facilities would be affected by ice layer formation on the lake.

Upon restart of the existing units and the circulation of warm water, the ice would gradually melt and break. The velocity induced by the flow can cause some of the ice floes to be withdrawn or moved by the water (Reference 31). Although the design of the intake has not been developed to enable the determination of ice floe size that might be withdrawn, the presence of trash racks and traveling screens would prevent such ice from reaching the pumps. The accumulation of ice at the trash racks and traveling screens could clog them and reduce the flow capacity of the intake structure. However, since emergency cooling and needed service water would be provided by the UHS, no safety-related facilities would be affected by ice floe accumulation on the lake.

SSAR Section 2.4.8, Cooling Water Canals and Reservoirs. This section is revised to reflect the use of a closed-cycle, dry and wet cooling tower system for proposed Unit 3 and to identify the make-up water and blowdown discharge flowrates. The 1st, 2nd, and 8th paragraphs of SSAR Section 2.4.8 will be revised to read as follows:

As described in Section 2.4.1, new Unit 3 would use a closed-cycle, dry and wet cooling tower system for the circulating water system. A separate, service water cooling system would utilize a closed-cycle, wet cooling tower for dissipation of waste heat from auxiliary heat exchangers not cooled by the plant circulating water system. Make-up water for the wet cooling towers would be supplied from the North Anna Reservoir at a maximum instantaneous rate of 49.6 cubic feet per second (cfs). Blowdown discharge from the wet cooling towers would be returned to the reservoir at a maximum instantaneous rate of 12.4 cfs via the WHTF through a new outfall located adjacent to the existing units' outfall at the head of the discharge channel.

As described in Section 2.4.1, new Unit 4 would use a closed-cycle cooling system with dry cooling towers to transfer the rejected heat to the atmosphere during normal plant operation. Dry towers would be used for both main condenser and plant service water cooling. These dry cooling systems would have practically no make-up water requirements, and no blowdown discharge. A dedicated pump bay in the new structure would be used to supply a small amount of make-up water to Unit 4, as required by the pump configuration selected for the closed-loop cooling water systems.

The discharge canal and the two interconnecting canals in the WHTF are each designed to convey approximately 8000 cfs (Reference 1). This capacity is in excess of the circulating water flow rate of 4246 cfs from the existing units plus the blowdown discharge of 12.4 cfs from the new Unit 3 wet cooling towers, the total being 4258 cfs. The new Unit 4 would not discharge any cooling water to the WHTF. Therefore, with the addition of Units 3 and 4, the normal design water level of Elevation 251.5 feet for the WHTF would not be affected, since total flow through the facility is less than the original 8000 cfs design capacity of the cooling water canals and discharge structure.

SSAR Section 2.4.10, Flooding Protection Requirements. This section is revised to indicate the use of a make-up water intake for the closed-cycle, dry and wet cooling tower system for proposed Unit 3. The 1st paragraph of SSAR Section 2.4.10 will be revised to read as follows:

The maximum design basis Lake Anna flood elevation, presented in Section 2.4.2, is 267.39 ft msl. This elevation is below the site grade at Elevation 271.0 ft msl. Since the ESP site grade is above the maximum water level, including wind setup and wave runup, the possibility of flooding above-grade, safety-related structures, systems, and components of the new units at the ESP site is precluded. Rip-rap protection of the slope embankment at the make-up water intake location on Lake Anna would be provided to prevent wave activity from eroding the embankment near the on-shore intake structure. It should be noted that although protection would be provided for this structure, the make-up water intake is not a safety-related facility.

SSAR Section 2.4.11.1, Low Flow in Streams. This section is revised to indicate that make-up water for the closed-cycle, dry and wet cooling tower system would be obtained from Lake Anna. The 3rd paragraph of SSAR Section 2.4.11.1 will be revised to read as follows:

Lake Anna, which was formed by the construction of the North Anna Dam on the North Anna River, provides cooling water for the existing units. Lake Anna would provide make-up water for the cooling towers proposed for the new units, as described in Section 2.4.1. Currently, the lake is maintained at an operating water level of 250 ft msl. The existing units can continue to operate with lake water levels as low as Elevation 242.0 ft msl before shutdown of the units must occur in accordance with the plant's Technical Requirements Manual (Reference 33). For the new units, the anticipated minimum lake level for operation is also Elevation 242.0 ft msl. All intake elevations would be based on this elevation, with sufficient margin to ensure plant operation during low water events. The historic low water levels in Lake Anna are presented in Section 2.4.11.3.

SSAR Section 2.4.11.3, Historical Low Water. This section is revised to reflect the use of a closed-cycle, dry and wet cooling tower system for proposed Unit 3. The 2nd paragraph of SSAR Section 2.4.11.3 will be revised to read as follows:

During drought conditions, the water level in the lake is determined by a combination of the lake inflow, dam release, lake evaporation, and any consumptive uses of water. The heat load rejected from the existing units influences lake evaporation. The closed-cycle, dry and wet cooling system for Unit 3 would consume additional water through cooling tower evaporation and reduce water levels during times of drought when inflow is insufficient to replace outflows from dam releases and evaporation. Water level impacts during drought conditions would, however, be mitigated through use of the dry towers, as is described in Part 3: Section 5.2. Unit 4 would use a closed-cycle cooling system with dry towers that typically have no evaporative losses, require no make-up water to replace evaporative loses, and have no blowdown discharge compared to mechanical (or natural) draft cooling towers. In the event the secondary cooling water loop of the selected dry tower system incorporates a pump sump with a free water surface, a small amount of evaporation will occur. The evaporation from this surface has been estimated to be about 1 gpm (0.002 cfs). Any make-up water necessary to replace these evaporative losses would be supplied from the reservoir. Given a make-up water demand of 1 gpm or less, Unit 4 operation would not impact Lake Anna water levels. The effects of new units on the Lake Anna water levels are presented in Section 2.4.11.4.

SSAR Section 2.4.11.4, Future Controls. This section is revised to reflect the use of a closed-cycle, dry and wet cooling tower system for proposed Unit 3 and to report the associated impacts on lake water levels. The 1st and 2nd paragraphs and associated Table 2.4-6 of SSAR Section 2.4.11.4 will be revised to read as follows:

Other than the required releases from the North Anna Dam, the only other consumptive water user for Lake Anna is the existing units. To determine the impact of new units on Lake Anna water levels, a water budget analysis of the lake with the existing and future units was performed. This analysis can be found in Part 3: Section 5.2.2. The period analyzed extended from October 1979 to April 2003 with two different water use scenarios investigated, which are described below.

Existing — The existing units running at a plant capacity factor of 93%, which is in excess of their historical operating experience.

Proposed — The existing units running as described above; new Unit 3 with an assumed 96% capacity factor using a closed-cycle, dry and wet cooling tower system, withdrawing make-up water from the North Anna Reservoir, and discharging blowdown to the WHTF; and new Unit 4 using a closed-cycle, dry cooling tower system with no make-up water need and no blowdown discharge to the WHTF.

The minimum calculated Lake Anna water levels for the Existing and Proposed scenarios are 245.1 and 244.2 ft msl, respectively. The durations of low lake water levels from the analysis are shown in Table 2.4-6. The minimum operating level for existing Units 1 & 2 and new Unit 3 (Elevation 242.0 ft msl) is below the minimum calculated under the Proposed scenario. Therefore, there would be no new impacts of low-flow conditions on the operation of either the existing Units 1 and 2 or new Unit 3.

Table 2.4-6 Lake Anna Low Water Level Durations

Lake Level (ft, msl)	Percent of the Time Water Level Is Less Than Indicated Value	
	Existing	Proposed
248.0	5.2%	7.0%
246.0	1.1%	1.4%
244.0	0%	0%
242.0	0%	0%

Existing – Unit 1 and 2 using once-through cooling

Proposed – Units 1 and 2 using once-through cooling; Unit 3 using closed-cycle cooling system with dry and wet cooling towers; Unit 4 using closed-cycle cooling system with dry cooling towers.

SSAR Section 15.3, Source Terms. This section is revised to scale up the ABWR source terms to the proposed ESBWR core thermal power of 4500 MWt. The 1st and 2nd paragraphs of SSAR Section 15.3 will be revised to read as follows:

Doses are calculated based on the time-dependent activities released to the environment during each DBA. The activities are based on the analyses used to support the reactor standard safety analysis reports. Different reactor technologies use different source terms and approaches in defining the activity releases. The ABWR source term is based on TID-14844 (Reference 1). Environmental releases are calculated using the guidance in NUREG-0800 and RGs 1.3 and 1.25 (Reference 2 and Reference 3, respectively). The AP1000 source terms, methodologies, and assumptions are based on the alternative source term methods outlined in RG 1.183. The activity releases and doses for the AP1000 and the ABWR are based on 102 percent of core thermal power. Assuming the ESBWR to be similar to the ABWR, the ABWR activity releases are scaled up from a power level of 4005 MWt (102 percent of 3926 MWt, as specified in the design certification) to 4590 MWt (102 percent of 4500 MWt, the power proposed for a new ESBWR unit at the ESP site), an adjustment factor of 1.15.

The IRIS and ACR-700 source term information are preliminary, but the AP-1000 LOCA is expected to bound the worst-case accident release for these advanced reactor concepts. The advanced gas reactor designs (GT-MHR and PBMR) use mechanistic accident source terms and postulate relatively small environmental releases, compared with the water reactor technologies. The activity releases to the environment are typically provided by the reactor vendors as part of their standard design packages.

SSAR Section 15.4, Radiological Consequences. This section is revised to scale up the ABWR doses to the proposed ESBWR core thermal power of 4500 MWt. The 2nd paragraph of SSAR Section 15.4 will be revised to read as follows:

Details about the methodology and assumptions pertaining to each of the accidents, such as activity release paths and the credited mitigation features, may be found in the design certification documents for the AP1000 (Reference 1) and the ABWR (Reference 2). As the ABWR design certification document presents whole body and thyroid doses, an equivalent TEDE value is estimated by multiplying the thyroid dose by 0.03 and adding the product to the whole body dose, in accordance with RG 1.183. Also, consistent with the activity releases in Section 15.3, the ABWR doses are scaled up by a factor of 1.15 from a power level of 4005 MWt (102 percent of 3926 MWt, as specified in the design certification) to 4590 MWt (102 percent of 4500 MWt, the power proposed for a new ESBWR unit at the ESP site). A summary of the resulting accident doses is presented in Table 15.4-1. This table also compares the accident doses to the recommended limits in RG 1.183 and NUREG-0800 and shows that the evaluated dose consequences are within the recommended limits.

SSAR Table 15.4-1, Summary of Design Basis Accident Doses. This section is revised to reflect scaling up to the ESBWR core thermal power of 4500 MWt. SRP Sections 15.6.2, 15.6.4, 15.6.5, and 15.7.4 of SSAR Table 15.4-1 will be revised to read as follows:

SRP Section	Accident	Reactor	TEDE (Rem) EAB	LPZ	Limit
15.1.5	PWR Main Steam Line Break				
	Pre-Existing Iodine Spike	AP1000	2.6E-01	6.1E-02	25
	Accident-Initiated Iodine Spike	AP1000	3.0E-01	2.2E-01	2.5
15.2.8	PWR Feedwater System Pipe Break	AP1000	3.0E-01	2.2E-01	2.5
15.3.3	Reactor Coolant Pump Rotor Seizure	AP1000	9.4E-01	9.1E-02	2.5
	(Locked Rotor Accident)	ABWR	Not Postulated		2.5
15.3.4	Reactor Coolant Pump Shaft Break	AP1000	9.4E-01	9.1E-02	2.5
		ABWR	Not Postulated		2.5
15.4.8	PWR Rod Ejection Accident	AP1000	1.1E+00	2.5E-01	6.3
15.4.9	BWR Control Rod Drop Accident	ABWR	Not Postulated		6.3
15.6.2	Failure of Small Lines Carrying	AP1000	4.9E-01	4.6E-02	2.5
	Primary Coolant Outside Containment	ABWR	4.5E-02	4.1E-03	2.5
15.6.3	PWR Steam Generator Tube Rupture				
	Pre-Existing Iodine Spike	AP1000	1.1E+00	5.2E-02	25
	Accident-Initiated Iodine Spike	AP1000	5.7E-01	3.7E-02	2.5
15.6.4	BWR Main Steam Line Break				
	Pre-Existing Iodine Spike	ABWR	5.4E-01	4.9E-02	25
	Accident-Initiated Iodine Spike	ABWR	2.6E-02	2.4E-03	2.5
15.6.5	Loss-of-Coolant Accident	AP1000	9.3E+00	1.5E+00	25
		ABWR	1.9E+00	2.2E+00	25
15.7.4	Fuel Handling Accident	AP1000	9.0E-01	9.1E-02	6.3
		ABWR	6.5E-01	5.9E-02	6.3

SRP Section	Accident	Reactor	TEDE (Rem) EAB	LPZ	Limit

Note: The AP1000 design certification indicates that the doses for the feedwater system pipe break are bounded by the main steam line break (Reference 1, Section 15.2.8.3).

The AP1000 design certification indicates that the doses for the reactor coolant pump shaft break are bounded by the reactor coolant pump rotor seizure (Reference 1, Section 15.3.4.2).

The ABWR design certification indicates that there are no radiological consequences for the reactor coolant pump rotor seizure, the reactor coolant pump shaft break, and the control rod drop accident (Reference 2, Sections 15.3.3.5, 15.3.4.5, and 15.4.10.6).

SSAR Table 15.4-11, Activity Releases for ABWR Failure of Small Lines Carrying Primary Coolant Outside Containment. This section is revised to reflect scaling up to the ESBWR core thermal power of 4500 MWt. SSAR Table 15.4-11 will be revised to read as follows:

	Activity Release (Ci)		
Isotope	0–2 hr	2–8 hr	Total
I-131	2.11E+00	2.26E+00	4.36E+00
I-132	1.84E+01	1.84E+01	3.68E+01
I-133	1.42E+01	1.50E+01	2.92E+01
I-134	3.07E+01	2.81E+01	5.88E+01
I-135	2.04E+01	2.11E+01	4.15E+01
Total	8.59E+01	8.48E+01	1.71E+02

SSAR Table 15.4-12, Doses for ABWR Failure of Small Lines Carrying Primary Coolant Outside Containment. This section is revised to reflect scaling up to the ESBWR core thermal power of 4500 MWt. The EAB and LPZ columns and Note of SSAR Table 15.4-12 will be revised to read as follows:

	ABWR EAB Dose (S_v)			χ/Q Ratio	Site TEDE (Rem)	
Time	W. Body	Thyroid	TEDE	(Site/ABWR)	EAB	LPZ
0–2 hr	9.40E-04	4.80E-02	2.38E-03	1.65E-01	4.50E-02	
0–8 hr	9.40E-04	4.80E-02	2.38E-03	1.50E-02		4.08E-03
8–24 hr						0.00E+00
24–96 hr						0.00E+00
96–720 hr						0.00E+00
Total	9.40E-04	4.80E-02	2.38E-03		4.50E-02	4.08E-03
Limit					2.5	2.5

Note: The ABWR TEDE is whole body dose plus 3% of thyroid dose. Since the ABWR design certification document does not include an LPZ dose for this accident, the site LPZ dose is obtained by multiplying the ABWR EAB dose by ratio of site LPZ χ/Q to ABWR EAB χ/Q. The site doses include a multiplier of 1.15 for power adjustment.

SSAR Table 15.4-17, Activity Releases for ABWR Main Steam Line Break. This section is revised to reflect scaling up to the ESBWR core thermal power of 4500 MWt. SSAR Table 15.4-17 will be revised to read as follows:

	Activity Release (Ci)	
Isotope	Pre-Existing	Accident Initiated
I-131	4.52E+01	2.26E+00
I-132	4.39E+02	2.20E+01
I-133	3.09E+02	1.55E+01
I-134	8.63E+02	4.33E+01
I-135	4.52E+02	2.26E+01
Kr-83m	7.55E-02	1.26E-02
Kr-85m	1.33E-01	2.22E-02
Kr-85	4.21E-04	6.99E-05
Kr-87	4.55E-01	7.55E-02
Kr-88	4.58E-01	7.61E-02
Kr-89	1.83E+00	3.06E-01
Kr-90	4.80E-01	7.89E-02
Xe-131m	3.28E-04	5.45E-05
Xe-133m	6.31E-03	1.05E-03
Xe-133	1.76E-01	2.93E-02
Xe-135m	5.38E-01	8.94E-02
Xe-135	5.01E-01	8.36E-02
Xe-137	2.29E+00	3.81E-01
Xe-138	1.75E+00	2.92E-01
Xe-139	8.02E-01	1.34E-01
Total	2.12E+03	1.07E+02

SSAR Table 15.4-18, Doses for ABWR Main Steam Line Break, Pre-Existing Iodine Spike. This section is revised to reflect scaling up to the ESBWR core thermal power of 4500 MWt. The EAB and LPZ columns and Note of SSAR Table 15.4-18 will be revised to read as follows:

	ABWR EAB Dose (S_v)			χ/Q Ratio	Site TEDE (Rem)	
Time	W. Body	Thyroid	TEDE	(Site/ABWR)	EAB	LPZ
0–2 hr	1.30E-02	5.10E-01	2.83E-02	1.65E-01	5.35E-01	
0–8 hr	1.30E-02	5.10E-01	2.83E-02	1.50E-02		4.85E-02
8–24 hr						0.00E+00
24–96 hr						0.00E+00
96–720 hr						0.00E+00
Total	1.30E-02	5.10E-01	2.83E-02		5.35E-01	4.85E-02
Limit					25	25

Note: The ABWR TEDE is whole body dose plus 3% of thyroid dose. Since the ABWR design certification document does not include an LPZ dose for this accident, the site LPZ dose is obtained by multiplying the ABWR EAB dose by ratio of site LPZ χ/Q to ABWR EAB χ/Q. The site doses include a multiplier of 1.15 for power adjustment.

SSAR Table 15.4-19, Doses for ABWR Main Steam Line Break, Accident-Initiated Iodine Spike. This section is revised to reflect scaling up to the ESBWR core thermal power of 4500 MWt. The EAB and LPZ columns and Note of SSAR Table 15.4-19 will be revised to read as follows:

	ABWR EAB Dose (S_v)			χ/Q Ratio	Site TEDE (Rem)	
Time	W. Body	Thyroid	TEDE	(Site/ABWR)	EAB	LPZ
0–2 hr	6.20E-04	2.60E-02	1.40E-03	1.65E-01	2.65E-02	
0–8 hr	6.20E-04	2.60E-02	1.40E-03	1.50E-02		2.40E-03
8–24 hr						0.00E+00
24–96 hr						0.00E+00
96–720 hr						0.00E+00
Total	6.20E-04	2.60E-02	1.40E-03		2.65E-02	2.40E-03
Limit					2.5	2.5

Note: The ABWR TEDE is whole body dose plus 3% of thyroid dose. Since the ABWR design certification document does not include an LPZ dose for this accident, the site LPZ dose is obtained by multiplying the ABWR EAB dose by ratio of site LPZ χ/Q to ABWR EAB χ/Q. The site doses include a multiplier of 1.15 for power adjustment.

SSAR Table 15.4-22, Activity Releases for ABWR Loss-of-Coolant Accident. This section is revised to reflect scaling up to the ESBWR core thermal power of 4500 MWt. SSAR Table 15.4-22 will be revised to read as follows:

	Activity Release (Ci)					
Isotope	**0–2 hr**	**2–8 hr**	**8–24 hr**	**24–96 hr**	**96–720 hr**	**Total**
I-131	2.97E+02	1.31E+02	1.06E+03	9.97E+03	7.12E+04	8.26E+04
I-132	4.03E+02	3.80E+01	3.71E+01	0.00E+00	0.00E+00	4.78E+02
I-133	6.20E+02	2.31E+02	1.35E+03	3.81E+03	7.74E+02	6.78E+03
I-134	5.88E+02	1.22E+00	0.00E+00	0.00E+00	0.00E+00	5.89E+02
I-135	5.89E+02	1.52E+02	3.80E+02	1.92E+02	0.00E+00	1.31E+03
Kr-83m	3.74E+02	5.33E+02	1.73E+02	0.00E+00	0.00E+00	1.08E+03
Kr-85	4.68E+01	3.53E+02	2.51E+03	2.49E+04	3.28E+05	3.56E+05
Kr-85m	9.66E+02	3.32E+03	5.00E+03	8.05E+02	0.00E+00	1.01E+04
Kr-87	1.37E+03	1.12E+03	1.05E+02	0.00E+00	0.00E+00	2.59E+03
Kr-88	2.43E+03	5.74E+03	3.93E+03	3.40E+02	0.00E+00	1.24E+04
Kr-89	2.07E+02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.07E+02
Xe-131m	2.43E+01	1.73E+02	1.28E+03	1.09E+04	7.12E+04	8.36E+04
Xe-133	8.74E+03	6.12E+04	4.31E+05	3.18E+06	9.62E+06	1.33E+07
Xe-133m	3.44E+02	2.49E+03	1.58E+04	8.69E+04	8.32E+04	1.89E+05
Xe-135	1.06E+03	5.25E+03	1.74E+04	1.34E+04	0.00E+00	3.71E+04
Xe-135m	5.57E+02	9.28E-02	0.00E+00	0.00E+00	0.00E+00	5.57E+02
Xe-137	5.88E+02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	5.88E+02
Xe-138	2.29E+03	1.55E-01	0.00E+00	0.00E+00	0.00E+00	2.29E+03
Total	2.15E+04	8.07E+04	4.80E+05	3.33E+06	1.02E+07	1.41E+07

SSAR Table 15.4-23, Doses for ABWR Loss-of-Coolant Accident. This section is revised to reflect scaling up to the ESBWR core thermal power of 4500 MWt. The EAB and LPZ columns and Note of SSAR Table 15.4-23 will be revised to read as follows:

Time	ABWR EAB Dose (S_v)			ABWR LPZ Dose (S_v)			χ/Q Ratio (Site/ABWR)	Site TEDE (Rem)	
	W. Body	Thyroid	TEDE	W. Body	Thyroid	TEDE		EAB	LPZ
0–2 hr	4.10E-02	1.90E+00	9.80E-02				1.65E-01	1.85E+00	
0–8 hr				1.00E-02	3.10E-01	1.93E-02	1.31E-01		2.91E-01
8–24 hr				8.00E-03	2.00E-01	1.40E-02	1.42E-01		2.27E-01
24–96 hr				1.10E-02	7.90E-01	3.47E-02	1.66E-01		6.61E-01
96–720 hr				9.00E-03	1.10E+00	4.20E-02	2.09E-01		1.01E+00
Total	4.10E-02	1.90E+00	9.80E-02	3.80E-02	2.40E+00	1.10E-01		1.85E+00	2.18E+00
Limit								25	25

Note: The ABWR TEDE is whole body dose plus 3% of thyroid dose. The site doses include a multiplier of 1.15 for power adjustment.

SSAR Table 15.4-26, Activity Releases for ABWR Fuel Handling Accident. This section is revised to reflect scaling up to the ESBWR core thermal power of 4500 MWt. SSAR Table 15.4-26 will be revised to read as follows:

	Activity Release (Ci)
Isotope	**0–2 hr**
I-131	1.41E+02
I-132	1.74E+02
I-133	1.45E+02
I-134	7.06E-06
I-135	2.36E+01
Kr-83m	7.37E+00
Kr-85m	9.78E+01
Kr-85	5.48E+02
Kr-87	1.41E-02
Kr-88	2.78E+01
Kr-89	9.32E-11
Xe-131m	9.56E+01
Xe-133m	1.26E+03
Xe-133	3.22E+04
Xe-135m	2.53E+02
Xe-135	7.30E+03
Xe-137	2.37E-10
Xe-138	4.92E-10
Total	4.23E+04

SSAR Table 15.4-27, Doses for ABWR Fuel Handling Accident. This section is revised to reflect scaling up to the ESBWR core thermal power of 4500 MWt. The EAB and LPZ columns and Note of SSAR Table 15.4-27 will be revised to read as follows:

	ABWR EAB Dose (S_v)			χ/Q Ratio	Site TEDE (Rem)	
Time	W. Body	Thyroid	TEDE	(Site/ABWR)	EAB	LPZ
0–2 hr	1.20E-02	7.50E-01	3.45E-02	1.65E-01	6.52E-01	
0–8 hr	1.20E-02	7.50E-01	3.45E-02	1.50E-02		5.92E-02
8–24 hr						0.00E+00
24–96 hr						0.00E+00
96–720 hr						0.00E+00
Total	1.20E-02	7.50E-01	3.45E-02		6.52E-01	5.92E-02
Limit					6.3	6.3

Note:The ABWR TEDE is whole body dose plus 3% of thyroid dose. The site LPZ dose is obtained by multiplying ABWR EAB dose by ratio of site LPZ χ/Q to ABWR EAB χ/Q. The site doses include a multiplier of 1.15 for power adjustment.

ER Section 1.1.3, Reactor Information. This Section is revised to incorporate the revised thermal output consistent with the changes to PPE Tables based on ESBWR output. The 2nd paragraph of ER Section 1.1.3 will be revised as follows:

No specific plant design has been chosen for the ESP site. Instead, a set of bounding plant parameters has been developed to envelop future site development. This plant parameters envelope (PPE) is based on the addition of power generation from two distinct units, to be designated as North Anna Units 3 and 4. Each unit represents a portion of the total generation capacity to be added and would consist of one or more reactors or reactor modules. These multiple reactors or modules (the number of which may vary depending on the reactor type selected) would be grouped into distinct operating units. The total nuclear generating capacity to be added would not exceed 4500 MWt per unit. Additional information regarding reactors addressed in the PPE is provided in Chapter 3.

ER Section 1.1.4, Cooling System Information. This section is revised to incorporate the Unit 3 cooling system change from once-through system to closed-cycle dry and wet cooling tower system. The description is revised to reflect make-up water supply from the lake, and blowdown discharge to WHTF to support the closed-cycle dry and wet cooling tower system. ER Section 1.1.4 will be revised to read as follows:

For normal plant cooling, a closed-cycle dry and wet cooling tower system, with make-up water supply from Lake Anna, would be used for the new Unit 3, whereas closed-cycle cooling, using dry towers, would be used for Unit 4.

Lake Anna is divided into two parts separated by earthen dikes. The North Anna Reservoir is the source of water for the existing units. The Waste Heat Treatment Facility (WHTF) receives cooling water discharges from the existing units.

Make-up water for the Unit 3 closed-cycle dry and wet tower system would be withdrawn from the North Anna Reservoir through a new intake structure located on a cove on the south shore of the lake, which was originally planned for the intake of the abandoned Units 3 and 4. This new structure would be adjacent to the existing units' intake structure. All cooling system discharges for both the existing units and the Unit 3 wet cooling tower blowdown would be sent to the WHTF via the existing discharge canal.

The new dry tower system of Unit 4 would introduce either no, or negligible, evaporative losses, and no additional heat load to Lake Anna.

Additional information on the cooling system is provided in Section 3.4.

ER Section 2.3.1.1, Surface Water. This section is revised to reflect the use of a closed-cycle, dry and wet cooling tower system for proposed Unit 3 and to identify the make-up water and blowdown discharge flowrates. The 2nd paragraph of ER Section 2.3.1.1 will be revised to read as follows:

Lake Anna is the primary surface water body that could affect plant water supply, or be affected by the construction and operation of new units at the ESP site based on the cooling systems proposed for the new units. New Unit 3 would use a closed-cycle, dry and wet cooling tower system for the circulating water system. A separate, service water cooling system would utilize a closed-cycle, wet cooling tower for dissipation of waste heat from auxiliary heat exchangers not cooled by the plant circulating water system. Make-up water for the wet cooling towers would be supplied from the North Anna Reservoir at a maximum instantaneous rate of 49.6 cubic feet per second (cfs). Blowdown discharge from the wet cooling towers would be returned to the reservoir at a maximum instantaneous rate of 12.4 cfs via the WHTF. New Unit 4 would use a closed-cycle cooling system with dry cooling towers in which the exhaust from the plant's steam turbines would be directed to a surface condenser where the heat of vaporization would be rejected to a closed loop of cooling water. The heated cooling water would be circulated to the finned tubes of the dry cooling towers where heat content of the cooling water would be transferred to the ambient air. To increase heat rejection to the atmosphere, electric motor driven fans would be used to force airflow across the finned tubes. After passing through the cooling towers, the cooled water would be recirculated back to the surface condenser to complete the closed-cycle cooling water loop. Except for the initial filling of the cooling water loop, Unit 4 would have no make-up water need since dry tower systems typically have no evaporative water losses and would have no continuous blowdown discharge to the WHTF. In the event that the cooling water loop would use an open pump sump configuration with a free surface, a small amount of evaporation losses, estimated to be on the order of 1 gpm (0.002 cfs), would occur. Any make-up water necessary to replenish the small evaporative losses for Unit 4, would be obtained from the North Anna Reservoir. The plant service water cooling system for Unit 4 would use dry cooling towers, which would have minimal to no make-up water requirements.

ER Section 2.3.3.1, Surface Water. This section is revised to reflect the use of a closed-cycle, dry and wet cooling tower system for proposed Unit 3 and to identify the make-up water source and blowdown. The 1st paragraph of ER Section 2.3.3.1 will be revised to read as follows:

As described in Section 2.3.1, it is anticipated that new Unit 3 would use a closed-cycle, dry and wet cooling tower system for the main condenser, with make-up water for the wet cooling towers being supplied from the North Anna Reservoir and blowdown discharge being returned to the reservoir via the WHTF.

ER Figure 2.3-2, Elevation-Storage Curves for North Anna Reservoir and Waste Heat Treatment Facility. This figure is revised to indicate that the WHTF and Reservoir curves are "Elevation – Storage" curves.

ER Figure 2.3-2 will be revised as follows:

[See next page]

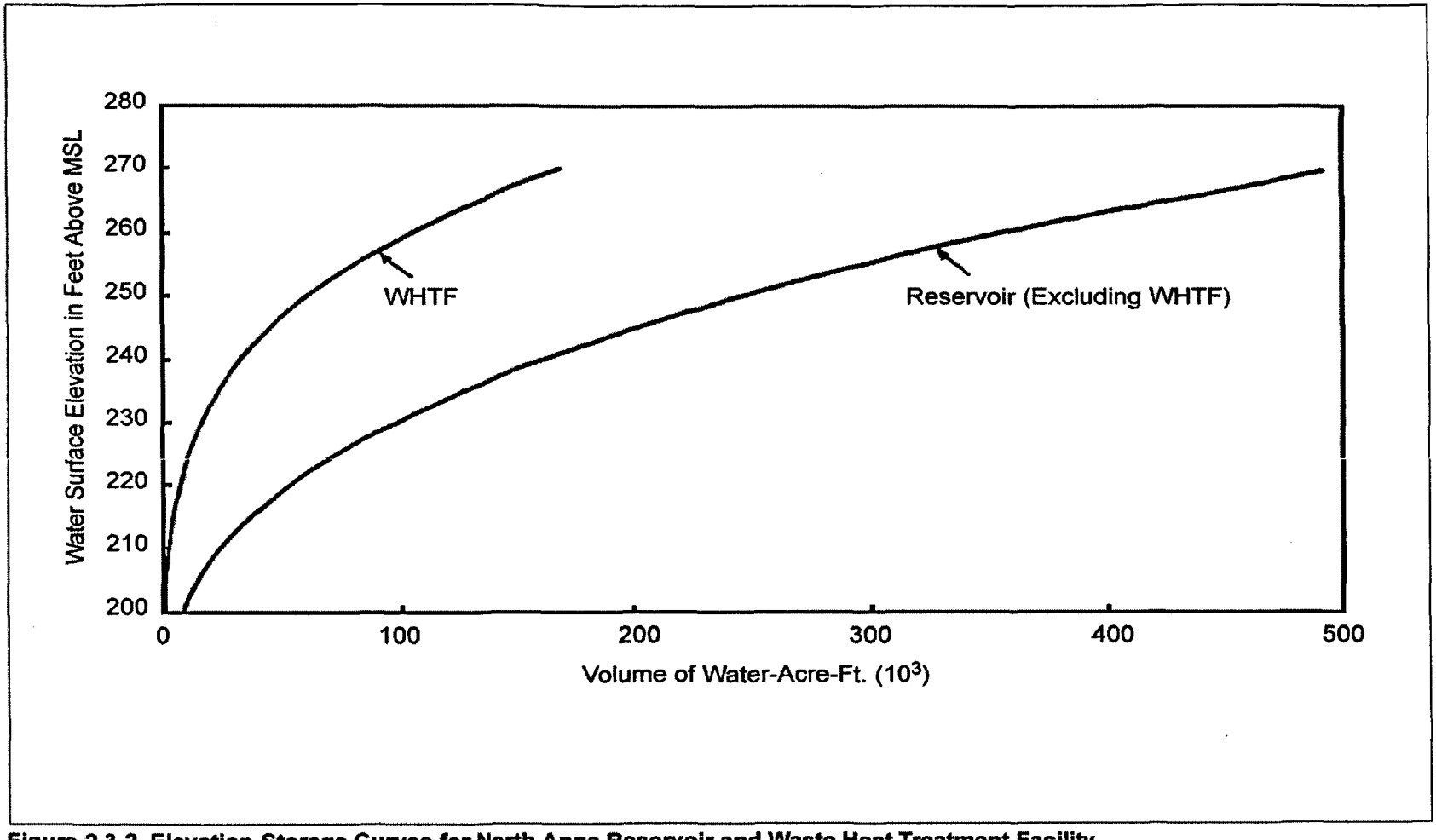


Figure 2.3-2 Elevation-Storage Curves for North Anna Reservoir and Waste Heat Treatment Facility

ER Section 2.4.1.8, Wetlands. This section has been revised to better describe the wetlands within the ESP site and to reflect the fact that Dominion has begun a wetlands delineation. ER Section 2.4.1.8 will be revised to read as follows:

Two intermittent streams flowing north into an unnamed arm of Lake Anna, just northwest of the power-block area bisect the area where cooling towers would be located. A narrow band of wetlands is associated with each of these streams. Other small, isolated wetlands may be present within the project footprint. Dominion has initiated a U. S. Army Corps of Engineers wetland delineation and will comply with all state and federal regulations regarding protection of wetlands (Reference 44).

ER Section 2.4 References. This reference is being added to reflect additional wetlands delineation of the ESP site

Reference 44 of ER Section 2.4 will be added as follows:

44. *Wetland Delineation at the North Anna Power Station,* Davis Environmental Consultants, Inc., November 14, 2005

ER Section 3.1.2.2, New Unit Description. This Section is revised to incorporate the revised thermal and electrical outputs consistent with the changes to PPE Tables based on ESBWR output. The description is revised to reflect make-up water supply from the lake, and blowdown discharge to WHTF to support the closed-cycle dry and wet cooling tower system. The 2nd, 4th, and 7th paragraphs of ER Section 3.1.2.2 will be revised to read as follows:

The unit sizes of these conventional plants also vary, with some individual units having reactor ratings of as much as 4500 MWt. The conventional style plants that are based on dual-reactor construction have individual power ratings significantly less than that stated above, and the 4500 MWt rating bounds these dual-reactor designs.

An operating unit or group of modules typically has a maximum total thermal power rating of not greater than 4500 MWt, with a maximum electrical capacity of about 1520 MWe. The structure would consist of between 1 and 8 reactors or reactor modules structured around a common support building and/or conventional turbine building. The ESP site can accommodate construction and operation of various numbers of new reactors and/or modules, configured as two operating units, up to a total of 9000 MWt or about 3040 MWe.

Unit 3 would use closed-cycle, combination dry and wet cooling towers which would be placed on the ESP site in the area shown for cooling towers on Figure 3.1-3. Unit 3 dry and wet cooling towers would be less than 80 feet high and cover an area of approximately 10 acres. Make-up water for Unit 3 wet cooling towers would be provided from Lake Anna. To extract make-up water from the Lake, a new intake structure would be constructed near the existing Unit 1 and 2 intake structure. Unit 4 would use dry cooling towers, with finned fan air coolers which would be placed on the ESP site in the area shown for cooling towers on Figure 3.1-3. The dry towers would be approximately 150 feet high, and would consist of a series of modules, each containing air-circulating fans. The dry tower modules would cover an area of approximately 24 acres.

ER Section 3.1.5, Site Developments and Improvements. This section is revised to incorporate the Unit 3 cooling system change from once-through system to closed-cycle, dry and wet cooling tower system. The 1st and 3rd paragraphs of ER Section 3.1.5 will be revised to read as follows:

A combination of dry and wet cooling towers would provide cooling for Unit 3. Dry cooling towers utilize water-to-air finned fan coolers to transfer heat through the finned tubes to the atmosphere. The dry tower would be comprised of fans passing air through finned tubes and discharging the air to the atmosphere. A series of tower modules would provide the needed cooling surface area for approximately one-third of Unit 3 heat duty at design ambient conditions. The dry towers themselves do not allow circulating water evaporation since the water is fully contained inside the tubes. The wet cooling towers would remove the heat by spraying the water into a forced air stream. The wet towers would have the capacity to meet all of Unit 3 condenser cooling requirements. The existing capacity of Lake Anna would allow Unit 3 (up to 4500 MWt) wet cooling tower system to draw make-up water from the lake. Cooling capacity of the lake and operating modes of dry and wet cooling towers are presented in Section 3.4. To extract make-up water from the lake, a new intake structure would be constructed, near the existing intake structure for the operating units. All cooling system discharges for both the existing units and the new Unit 3 cooling tower blowdown would be sent to the WHTF via the existing discharge canal. The new intake structure would be designed to be complementary in appearance to the existing structures.

Operation of the cooling fans in the towers would create an audible noise. By using standard design techniques, the noise contribution from the dry tower and wet tower systems would produce impacts below 60–65 dBA at the EAB. Tower height is presented in Section 3.1.2.2. The proposed tower locations, indicated in Figure 3.1-3, are west of the proposed locations for new units.

ER Table 3.1-1, Plant Parameters Envelope. This table is revised to reflect changes to the PPE as a result of ESBWR design power level increase and change in method of cooling. PPE Sections 2.2.1, 2.2.2, 2.5.1.1, 2.5.3, 2.5.4.1, 2.5.5, 15.1.1, and 16.3 of ER Table 3.1-1 will be revised to read as follows:

[See next page]

Table 3.1-1 Plant Parameters Envelope

PPE Section		Bounding Value [Value for 2 Units in brackets]	Bound Notes See Table 3.1-2	Comments	Definition
2.2.1	Max Inlet Temp Condenser/ Heat Exchanger	100°F [Same for 2nd unit/group.]	2,3,4		Design assumption for the maximum acceptable circulating water temperature at the inlet to the condenser or cooling water system heat exchangers.
2.2.2	Condenser/Heat Exchanger Duty	1.03 E10 btu/hr [Additional 1.03 E10 btu/hr for 2nd unit/group]	11		Design value for the waste heat rejected to the circulating water and service water systems.
2.5.1.1	DELETED				
2.5.3	Cooling Water Temperature Rise	18°F [Same for 2nd unit/group.]	1, 3, 5	g	Temperature rise across the condenser (temperature of water out minus temperature of water in).
2.5.4.1	DELETED				
2.5.5	Heat Rejection Rate	1.03 E10 Btu/hr [2.06 E10 Btu/hr]	11		The expected heat rejection rate.

Table 3.1-1 Plant Parameters Envelope

PPE Section	Bounding Value [Value for 2 Units in brackets]	Bound Notes See Table 3.1-2	Comments	Definition
15.1.1 Diesel Capacity	2 x 15,000 kw [4 x 15,000 kw]	11		The capacity of diesel engines used for generation of standby electrical power.
16.3 Megawatts Thermal	4500 MWt [9000 MWt]	11		The thermal power generated by one unit (may be the total of several modules).

ER Table 3.1-9, ESP Site Characteristics and Design Parameters. This table is revised to reflect the use of cooling towers in lieu of once-through cooling and the increase in ESBWR design power level. ER Table 3.1-9, Items "Normal Plant Heat Sink," "Ultimate Heat Sink," and "Plant Characteristics" will be revised to read as follows:

Item	Single Unit/Group Value [Second Unit/Group Value]	Description and References
Normal Plant Heat Sink		• Item 2 of Table 3.1-1
• Condenser / Heat Exchanger Duty	≤ 1.03 E10 Btu/hr [Additional 1.03 E10 Btu/hr for 2nd unit/group]	• Waste heat rejected from the main condenser and the auxiliary heat exchangers during normal plant operation at full station load • Item 2.2.2 of Table 3.1-1 • Refer to Sections 3.4.1.1, 3.4.1.3, 3.4.2.3, 5.3.2.1, 5.3.2.1.2.
• Maximum Inlet Temperature Condenser/ Heat Exchanger	100°F [Same for 2nd unit/group]	• Maximum water temperature at condenser and heat exchanger inlet • Item 2.2.1 of Table 3.1-1 • Refer to Section 3.4.1.3.2.
• Unit 3 Closed-cycle Dry and Wet Tower Cooling		• Item 2.3 of Table 3.1-1
Make-up Flow Rate	15,385 gpm, maximum (MWC mode) 22,269 gpm, maximum (EC mode)	• The expected rate of removal of water from Lake Anna to replace water losses from the closed-cycle cooling water system. • Item 2.3.9 of Table 3.1-1 • Refer to Sections 3.4.1.1, 3.4.2.1, 5.2.1.1, 5.3.1, 5.3.1.1, 5.3.1.1.2, Table 3.3-1; Figure 3.3-1.
Evaporation Rate	8303 gpm, average (96% plant capacity factor with wet tower cooling) 11,532 gpm, maximum (MWC mode) 16,695 gpm, maximum (EC mode)	• Expected rates at which water is lost by evaporation resulting from operation of the plant cooling towers. • Item 2.3.7 of Table 3.1-1 • Refer to Section 5.2.1.1; Table 3.3-1; Figure 3.3-1.
Blowdown Flow Rate	3844 gpm, maximum (MWC mode) 5565 gpm, maximum (EC mode)	• Flow rate of the blowdown stream from the closed-cycle cooling water system to the WHTF. • Item 2.3.4 of Table 3.1-1 • Refer to Sections 3.4.2.2, 5.2.1.1, 5.3.1.1, 5.3.1.1.2, 5.3.2.1.2 & 5.3.2.1.3; Table 3.3-1; Figure 3.3-1.

Item	Single Unit/Group Value [Second Unit/Group Value]	Description and References
Blowdown Temperature	100°F	• The maximum expected temperature of the cooling tower blowdown stream to the WHTF. • Item 2.3.5 of Table 3.1-1 • Refer to Section 3.4.1.1 & 5.3.2.2.2
Blowdown Constituents and Concentrations		• The maximum expected concentrations for anticipated constituents in the cooling water system blowdown to the WHTF. • Item 2.3.3 of Table 3.1-1 • Refer to Section 5.5.1.1
• Free Available Chlorine	<0.3 ppm	
• Copper	<1 ppm	
• Iron	<1 ppm	
• Sulfate	<300 ppm	
• Total Dissolved Solids	<3000 ppm	
Heat Rejection Rate	≤ 1.03 E10 Btu/hr	• The expected maximum heat rejection rate to the atmosphere during normal operation at full station load • Refer to Sections 3.4.1.1, 3.4.1.3.1, 3.4.2.3, 5.3.2.1 & 5.3.2.1.2.
• Unit 4 Dry Cooling Towers		
Evaporation Rate	None or negligible (on the order of 1 gpm, average)	• The expected rate at which water is lost by evaporation from the cooling water system • Refer to Sections 1.1.4, 2.3.1.1, 3.1.5, 3.3.1, 3.4.1.1, 5.2.1, 5.2.2.1.2, 5.3.3.1 & 5.3.3.2.1; Table 3.3-2; Figure 3.3-2.
Height	≤ 150 ft	• The vertical height above finished grade of the cooling towers • Refer to Sections 3.1.2.2, 5.3.3.2.4 & 5.8.1.5.
Make-up Flow Rate	None or negligible (on the order of 1 gpm, average)	• The expected rate of removal of water from Lake Anna to replace evaporative water losses from the cooling water system • Refer to Sections 2.3.1.1, 2.3.3.1, 3.3.1, 3.4.1.1, 3.4.2.1, 5.2.1, 5.2.1.1, 5.2.1.4, 5.3.1, 5.3.1.1, 5.3.1.2.2 & 5.3.3.1; Table 3.3-2; Figure 3.3-2.
Noise	< 60 – 65 dbA at EAB	• Maximum expected sound level produced by operation of the cooling towers • Refer to Sections 3.1.5, 5.3.3.2.3, 5.3.4.2 & 5.8.1.2.

Heat Rejection Rate	≤ 1.03 E10 Btu/hr	• The expected maximum heat rejection rate to the atmosphere during normal operation at full station load • Refer to Sections 3.4.1.1, 3.4.1.3.1 & 3.4.2.3.
Ultimate Heat Sink Mechanical Draft Cooling Towers		• Item 3 of Table 3.1-1 • Item 3.3 of Table 3.1-1
• Blowdown Constituents and Concentrations	[Values same for both units/group]	• The maximum expected concentrations for anticipated constituents in the UHS blowdown to the WHTF • Item 3.3.3 of Table 3.1-1 • Refer to Section 5.5.1.1.
- Free Available Chlorine	<0.3 ppm	
- Copper	<1 ppm	
- Iron	<1 ppm	
- Sulfate	<300 ppm	
- Total Dissolved Solids	<3000 ppm	
• Blowdown Flow Rate	144 gpm expected, 850 gpm maximum [288 gpm expected, 1700 gpm maximum]	• The normal expected and maximum flow rate of the blowdown stream from the UHS system to the WHTF • Item 3.3.4 of Table 3.1-1 • Refer to Sections 3.4.1.2, 3.4.2.2 & 5.3.2.1; Tables 3.3-1 & 3.3-2; Figures 3.3-1 & 3.3-2.
• Evaporation Rate	411 gpm normal, 850 gpm shutdown [822 gpm normal, 1700 gpm shutdown]	• The expected (and maximum) rate at which water is lost by evaporation from the UHS system • Item 3.3.7 of Table 3.1-1 • Refer to Section 3.4.1.2; Tables 3.3-1 & 3.3-2; Figures 3.3-1 & 3.3-2.
• Height	≤ 60 ft [Same for 2nd unit/group]	• The vertical height above finished grade of mechanical draft cooling towers associated with the UHS system. • Item 3.3.8 of Table 3.1-1 • Refer to Section 3.1.5.
• Maximum Consumption of Raw Water	850 gpm, nominal [1700 gpm]	• The expected maximum short-term consumptive use of water from Lake Anna by the UHS system (evaporation and drift losses) • Item 3.3.14 of Table 3.1-1 • Refer to Tables 3.3-1 & 3.3-2; Figures 3.3-1 & 3.3-2.
• Monthly Average Consumption of Raw Water	411 gpm [822 gpm]	• The expected normal operating consumption of water from Lake Anna by the UHS system (evaporation and drift losses) • Item 3.3.15 of Table 3.1-1 • Refer to Tables 3.3-1 & 3.3-2; Figures 3.3-1 & 3.3-2.

• Megawatts Thermal	≤ 4500 MWt [≤ 9000 MWt]	• The thermal power generated by one unit (may be the total of several modules) • Item 16.3 of Table 3.1-1 • Refer to Sections 1.1.3, 3.1.2.2, 3.1.5, 3.2.1, 3.8.1, 5.7.1, 7.1.3 & 7.1.4; Tables 3.8-1, 5.4-6, & 5.4-7

ER Section 3.2, Reactor Power Conversion System. This Section is revised to incorporate the revised thermal and electrical outputs consistent with the changes to PPE Tables based on ESBWR output. Revised plant and site equipment power requirements and net output based on revised electrical output and cooling system changes. ER 3.2 will be revised to read as follows:

For the ESP site, the selection of the reactor and power conversion system has not been made. In its place, a detailed PPE was developed to describe the maximum potential impacts. This PPE is included as Table 3.1-1. The site has a potential development of up to approximately 3040 MWe (gross), which would be achieved with two power blocks to be called Units 3 and 4. Each unit could consist of several reactors or modules, perhaps as many as eight, depending on the reactor technology selected.

ER Section 3.2.1, Reactor Description. This Section is revised to incorporate the revised thermal and electrical outputs consistent with the changes to PPE Tables based on ESBWR output. Revised plant and site equipment power requirements and net output based on revised electrical output and cooling system changes. The 2nd paragraph of ER Section 3.2 1 will be revised to read as follows:

Each unit would consist of a maximum 4500 MWt reactor(s) and associated turbines and power conversion equipment. The gross electrical output of each unit of approximately 1520 MWe is dependent on circulating water inlet temperature and condenser design. Plant and site equipment would require approximately 30–100 MWe, resulting in an approximate maximum net 1420–1490 MWe output.

ER Section 3.2.3, Power Conversion Systems. This section is revised to reflect the change to closed-cycle combination dry and wet cooling towers. ER Section 3.2.3 will be revised to read as follows:

The type of power conversion system used would depend upon the type of reactor deployed. The gas-cooled reactor uses a gas turbine system to convert the heat energy to mechanical energy, while the water-cooled reactor uses a steam turbine for the same purpose. Waste heat from Unit 3 would be rejected from either turbine type to the closed-cycle combination dry and wet cooling towers and from Unit 4 to dry cooling towers. The tube material for the condenser or turbine exhaust cooling heat exchangers (depending on reactor type) has not been selected.

ER Section 3.3, Plant Water Use. This section is updated to incorporate the combination dry and wet cooling tower system for Unit 3 plant cooling water system. The previous plant cooling water system was Once-Through Cooling. The water use associated with the combination of wet and dry cooling towers is incorporated in Table 3.3-1. The 2nd paragraph of ER Section 3.3 will be revised to read as follows:

Plant cooling for the first new unit at the ESP site would use closed–cycle, combination dry and wet cooling towers. The second unit would use dry cooling towers. Cooling tower make-up water necessary to replace the water lost to evaporation would be obtained from the North Anna Reservoir. Plant water sources would come from two sources – Lake Anna and local wells – depending on the quantity and quality of make-up water required.

ER Section 3.3.1, Water Consumption. This section is revised to reflect the change from once-through cooling to cooling towers for Unit 3. ER Section 3.3.1 will be revised to read as follows:

Two new units at the ESP site would require the use of additional water for both plant cooling and internal consumption. Unit 3 would use closed–cycle, combination dry and wet cooling towers with make-up water from the North Anna Reservoir. Unit 4 would use dry cooling towers, with make-up from the North Anna Reservoir, if needed. Dry cooling towers prevent evaporation of the cooling water and significantly reduce the need for make-up water. In the event that the cooling water loop would use an open sump pump configuration with a free surface, a small amount of evaporation loss would occur, estimated to be on the order of 1 gpm. This small quantity of make-up water would be drawn from Lake Anna. The lake would also be used as a source of operating water supply for the fire protection system and the plant demineralized water supply for both units. Potable water supplies would be drawn from groundwater wells. The data listed in Table 3.3-1 and Table 3.3-2 reflect this arrangement.

Hydrological impacts of this arrangement are provided in Section 5.2.1 and water use impacts are provided in Section 5.2.2.

Figure 3.3-1 through Figure 3.3-3 outline the water use for the new units. As stated earlier (Section 3.3), the water balance for the new units is based on data from the PPE and on site-specific parameters. Evaporation estimates for Unit 3 wet cooling towers and the Unit 4 dry cooling tower collection basin are based on site-specific data (see Section 5.2.1 and Section 5.2.2). Any future development would be bounded by the information in this table.

ER Section 3.3.1.1, Plant Water Use. This section is revised to reflect the change from once-through cooling to cooling towers for Unit 3. ER Section 3.3.1.1 will be revised to read as follows:

The total water use for new units for which the ESP site may be used is shown in tabular form in Table 3.3-1 and Table 3.3-2. This includes make-up water for the cooling towers, water supply for the potable water system, water supply for the demineralized water system, and the fire protection system requirements. As indicated in the tables, water use for the site would depend on the number of units constructed. The normal values listed are expected limiting values for normal plant operation. The maximum values are those expected for upset or abnormal conditions. Figure 3.3-3 is typical for both new units and illustrates water requirements for the potable water systems, demineralized water supplied systems and the fire protection system. It should be noted that fire protection water consumption maximums are based on system actuation, which is an event-based activity. Normal water consumption is that required to maintain system availability. Figure 3.3-1 and Figure 3.3-2 illustrate water use for the cooling systems of Units 3 and 4, respectively.

ER Section 3.3.2.1, Raw Water. This section is revised to address the need for make-up water treatment for the Unit 3 cooling tower system. ER Section 3.3.2.1 will be revised to read as follows:

Cooling tower make-up water for Unit 3 would be from the North Anna Reservoir. Make-up water necessary for Unit 3 cooling towers would need treatment for biofouling, scaling, and suspended matter, with acceptable biocides, antiscalants, and dispersants, respectively.

Raw water from the North Anna Reservoir that could be used to provide make-up for various station secondary systems would also require treatment.

Any make-up water necessary for cooling tower(s), including the towers supporting Unit 4, would need treatment for biofouling, scaling, and suspended matter, with acceptable biocides, antiscalants, and dispersants, respectively.

ER Section 3.3.2.2, Make-up Water. This section is revised to address make-up water treatment for other systems. ER Section 3.3.2.2 will be revised to read as follows:

Make-up water from the North Anna Reservoir for other systems would be treated systematically and thoroughly with a process that includes ultra-filtration, reverse osmosis (RO), and electro-deionization, which results in highly purified water for various plant systems. In the final stages of the purification process, the treated water passes through ion exchange beds and is then de-oxygenated by gaseous hydrogen passing over a catalytic bed (palladium) (Reference 1). Once purified, the make-up water would most likely to be directed to the following water supplies:

- Condensate
- Primary
- Closed cooling (for various subsystems)

ER Table 3.3-1, Unit 3 Water Consumption. This table summarizes the various water supplies and releases for Unit 3 that are addressed throughout Section 3.3 ER Table 3.3-1 will be revised to read as follows:

Service	Normal (gpm/cfs)[a]	Maximum (gpm/cfs)[a]	Reference (PPE Section)[d]
Water Supplies[e]			
UHS Cooling Tower Make-up	555/1.24	1700/3.79	3.3.9
Plant Cooling Tower Make-up[b c]	15,385/34.3	22,269/49.6	
Potable Water Supply	90/0.2	120/0.27	5.2.1 and 5.2.2
Demin Water Supply	550/1.23	720/1.60	6.2.1 and 6.2.2
Fire Protection Water Supply	15/0.03	2500/5.57	7.1.1 and 7.1.2
Water Releases			
Evaporation Rate[c]			
Plant Cooling Tower[b c]	11,532/25.7	16,695/37.2	
UHS Tower	411/0.92	850/1.89	3.3.7
Blowdown			
UHS Tower	144/0.32	850/1.89	3.3.4
Plant Cooling Tower[b c]	3,844/8.57	5,565/12.4	
Sanitary Waste Discharge	60/0.13	105/0.23	5.1.1
Rad Waste Discharge	100/0.22	100/0.22	10.2.1
Misc. Drains Discharge	100/0.22	150/0.33	8.1.1
Demin Water Discharge	110/0.25	150/0.33	6.1.1

a. Flow rates were converted from gpm to cfs.
b. Normal for Plant Cooling Tower Make-up, Evaporation and Blowdown is "Maximum Water Conservation" (MWC) mode (2/3 heat dissipated in wet cooling towers and 1/3 heat dissipated in dry cooling towers) and Maximum is "Energy Conservation" (EC) mode (all heat dissipated in the wet cooling towers)
c. The "Plant Cooling Tower" reference has contributions from circulating water wet and dry cooling towers and service water wet towers. Values are expected maximums at design 0.4% exceedance atmospheric conditions.
d. Reference refers to the line entry on the PPE, Table 3.1-1.
e. Make-up water for Plant Cooling Towers, UHS Tower, Demineralized Water, and Fire Protection Water would be from Lake Anna. The potable water supply would be from area wells.

ER Table 3.3-2, Unit 4 Water Consumption. This table summarizes the various water supplies and releases for Unit 4 that are addressed throughout Section 3.3 ER Table 3.3-2 will be revised to read as follows:

Service	Normal (gpm/cfs)[a]	Maximum (gpm/cfs)[a]	Reference (PPE Section)[e]
Water Supplies[b]			
UHS Tower Cooling Tower Make-up (Lake Water)	555/1.24	1700/3.79	3.3.9
Plant Cooling Tower Make-up[c d]	1.0/0.002	1.0/0.002	See note [d]
Potable Water Supply (Raw Water)	90/0.2	120/0.27	5.2.1 and 5.2.2
Demin Water Supply (Raw Water)	550/1.23	720/1.60	6.2.1 and 6.2.2
Fire Protection Water Supply (Raw Water)	15/0.03	2500/5.57	7.1.1 and 7.1.2
Water Releases			
Evaporation Rate			
UHS Tower	411/0.92	850/1.89	3.3.7
Plant Cooling Towers [d]	1.0/0.002	1.0/0.002	See ER Section 5.2.1
Blowdown			
UHS Tower	144/0.32	850/1.89	3.3.4
Plant Cooling Towers[d]	0	0	See ER Section 5.2.1
Sanitary Waste Discharge	60/0.13	105/0.23	5.1.1
Rad Waste Discharge	100/0.22	100/0.22	10.2.1
Misc. Drains Discharge	100/0.22	150/0.33	8.1.1
Demin Water Discharge	110/0.25	150/0.33	6.1.1

a. Flow rates were converted from gpm to cfs.
b. Make-up water for Plant Cooling Towers, UHS Tower, Demineralized Water, and Fire Protection Water would be from Lake Anna. The potable water supply would be from area wells.
c. Unit 4 would use dry cooling towers. If an open sump pump configuration is used, a maximum 1 gpm evaporation rate would occur.
d. The "Plant Cooling Tower" reference has contributions from circulating water cooling tower and the service water cooling tower.
e. Reference refers to the line entry on the PPE, Table 3.1-1.

ER Figure 3.3-1, Unit 3 Cooling Water Use. This figure provides a visual summary of the various water supplies and releases for Unit 3 that are addressed throughout Section 3.3. ER Figure 3.3-1 will be revised as follows:

[See next page]

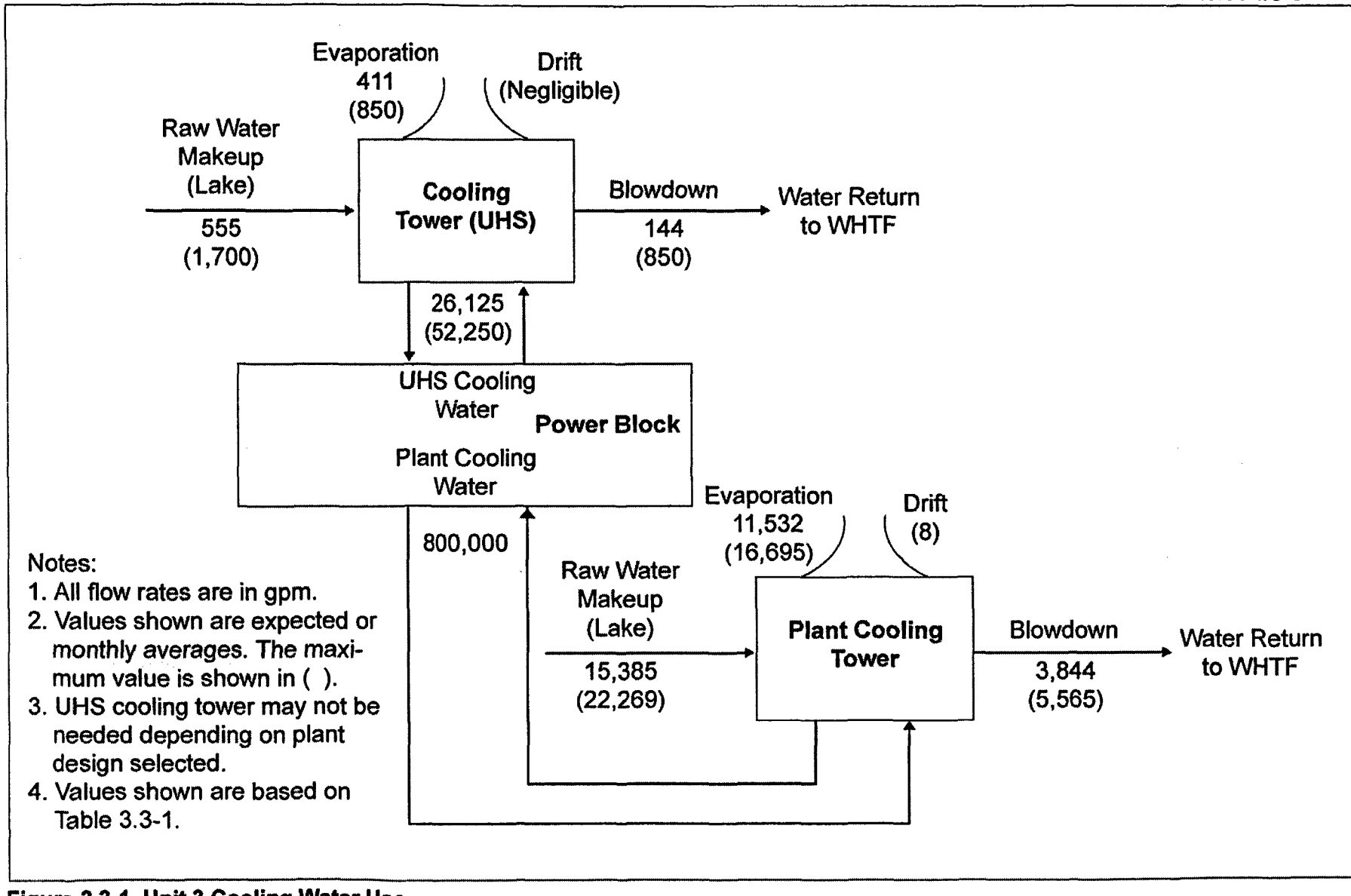


Figure 3.3-1 Unit 3 Cooling Water Use

ER Figure 3.3-2, Unit 4 Cooling water Use. This figure provides a visual summary of the various water supplies and releases for Unit 4 that are addressed throughout Section 3.3. ER Figure 3.3-2 will be revised as follows:

[See next page]

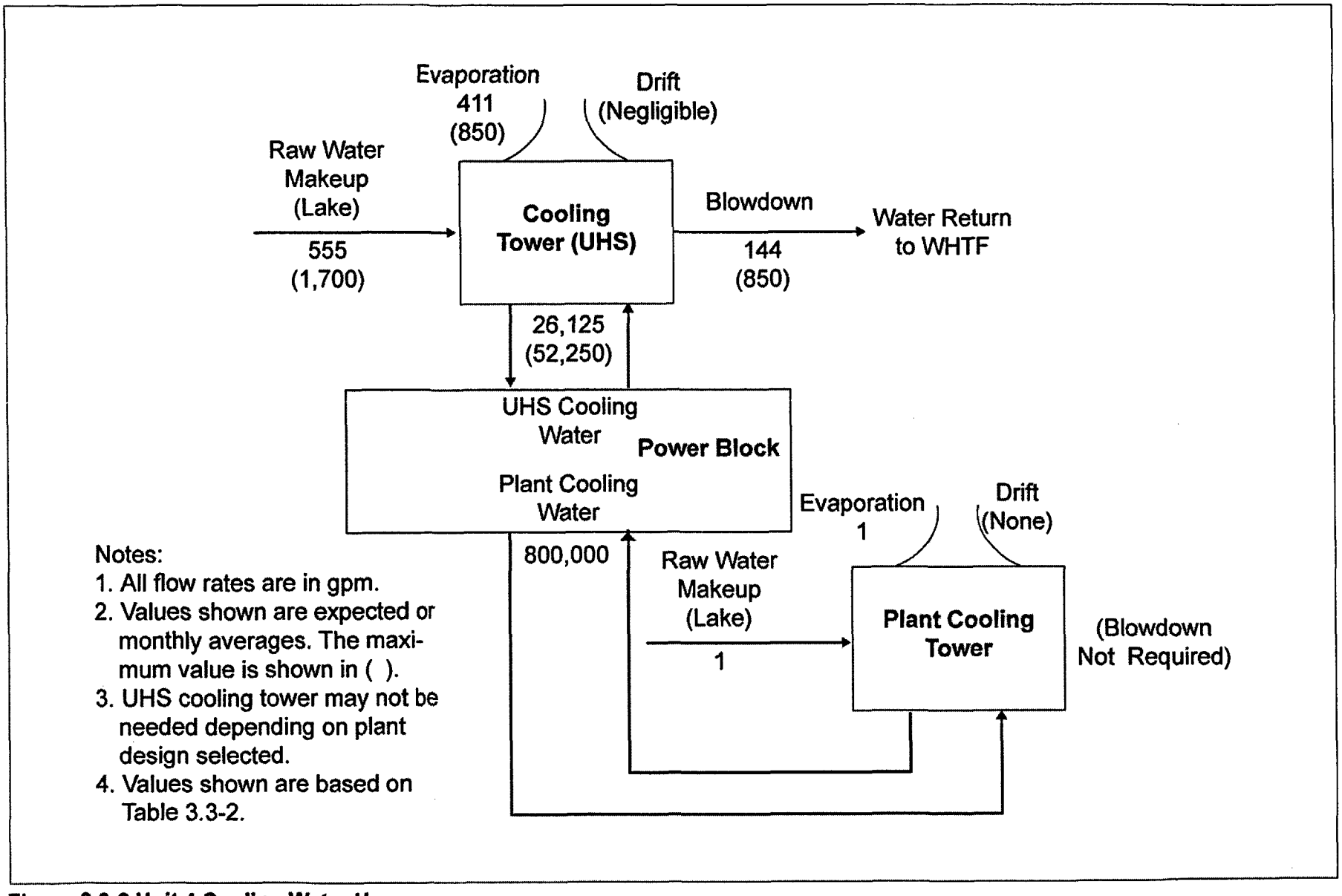


Figure 3.3-2 Unit 4 Cooling Water Use

ER Section 3.4.1.1, Normal Plant Cooling. This section is revised to reflect the use of a closed-cycle combination dry and wet cooling tower system for the circulating water system of the proposed Unit 3, and to describe the operating modes of the combination tower system and the make-up and blowdown flow rates. The circulating water flow rate of the dry tower cooling system of Unit 4 is also revised. ER Section 3.4.1.1 will be revised to read as follows:

According to the PPE, each new unit would require cooling systems to dissipate up to 1.03×10^{10} BTU/hr of waste heat rejected from the main condenser and the unit's auxiliary heat exchangers during normal plant operation at full station load. The primary normal plant cooling system, hereafter referred to as the circulating water system, would dissipate heat from the main condenser and potentially other auxiliary heat exchangers. A closed-cycle, combination dry and wet cooling tower arrangement would be used for the circulating water system of the new Unit 3, and a closed-cycle dry cooling tower system would be used for the new Unit 4. Dissipation of waste heat from auxiliary heat exchangers not cooled by the plant circulating water system is typically performed by the plant service water system. The typical plant service water system water flows, heat dissipation, and losses are included in the plant cooling water system values for each unit. The service water cooling system would utilize a closed-cycle wet cooling tower system for Unit 3 and a dry cooling tower system for Unit 4.

Unit 3's circulating water system would use both dry cooling towers and wet cooling towers for heat dissipation. Exhaust from the plant's steam turbines would be directed to a surface condenser where the heat of vaporization would be rejected to the cooling water in a closed loop. The heated cooling water would be circulated first to the finned tubes of the dry cooling towers where heat content of the cooling water would be transferred to the ambient air. To increase heat rejection to the atmosphere, electric motor driven fans would be used to force airflow across the finned tubes. No water loss would occur in the dry cooling towers. Cooling water leaving the dry towers would then pass through the wet towers to remove the balance of condenser/heat exchanger rejected heat by spraying the water into a forced air stream. The wet towers would incorporate water saving features to reduce evaporative water losses. After passing through the cooling towers, the cooled water would be recirculated back to the surface condenser to complete the closed-cycle cooling water loop. Make-up water to the circulating water system and service water cooling system would be obtained from the North Anna Reservoir. Blowdown from the cooling systems would be discharged to the existing plant WHTF discharge canal.

The Unit 3 circulating water system would operate under two modes:

- Energy Conservation (EC) – Dry cooling will be reduced with reliance mostly on wet towers for heat removal.

- Maximum Water Conservation (MWC) – A minimum of 1/3 of the heat will be removed by the dry towers with the remainder removed by the wet towers.

When North Anna Reservoir level is at or above 250 ft msl and adequate reservoir discharge is being maintained, the EC mode would be used. However, if reservoir level falls below 250 ft msl and if the level is not restored within a reasonable period of time (e.g., 7 days), the MWC mode would be used.

The Unit 4 system would use dry cooling towers for heat dissipation in which the exhaust from the plant's steam turbines would be directed to a surface condenser where the heat of vaporization would be rejected to a closed loop of cooling water. The heated cooling water would be circulated to the finned tubes of the dry cooling towers where heat content of the cooling water would be transferred to the ambient air. To increase heat rejection to the atmosphere, electric motor driven fans would be used to force airflow across the finned tubes. After passing through the dry cooling towers, the cooled water would be recirculated back to the surface condenser to complete the closed-cycle cooling water loop. Except for the initial filling of the cooling water loop, Unit 4's circulating water and service water cooling systems would have no make-up water need since dry tower systems typically have no evaporative water losses and would have no continuous blowdown discharge to the WHTF. In the event that the cooling water loop would use an open pump sump configuration with a free surface, a small amount of evaporation losses, estimated to be on the order of 1 gpm (0.002 cfs), will occur. Any make-up water necessary to replenish the small evaporative losses for Unit 4's circulating water system and service water cooling system would be obtained from the North Anna Reservoir. Since there would be minimal, if any, make-up water requirement and no blowdown discharge to the WHTF from the Unit 4 dry cooling systems, impacts to Lake Anna would be minimal.

In the closed-cycle wet and dry cooling system for new Unit 3, pumps would circulate water in a closed loop of cooling water at an expected rate of about 3.355×10^8 lbs/hr (approximately 1500 cfs at a maximum temperature of 100°F). The circulating water flow rate may vary depending on the final selected parameters of the unit condenser. Make-up water to the circulating water and service water cooling systems would be taken from the North Anna Reservoir by make-up water pumps at a maximum instantaneous rate of 2.23×10^4 gpm (49.6 cfs) when not operating in the MWC mode. The make-up water pumps would be installed inside a new shoreline intake structure located in a cove west of the intake structure for the existing units. Blowdown from the circulating water and service water cooling systems of Unit 3 would be discharged to an outfall structure located at the head of the WHTF discharge canal at a temperature no greater than 100°F and a flow rate no greater than 5.57×10^3 gpm (12.4 cfs). At the maximum instantaneous blowdown flow rate of 12.4 cfs at 100°F discharge temperature, the heat

rejected from the closed cycle cooling systems of Unit 3 to the WHTF would be on the order of 4.2×10^7 BTU/hr during the extreme summer months when the wet-bulb temperature is close to 80°F, and the average lake temperature is in the mid-80°F range. Compared to the once-through cooling system discharge of the existing units which have a combined design heat content of up to 1.35×10^{10} BTU/hr, the heat load in the blowdown discharge of Unit 3 would be about 0.3 percent of the heat load from the existing units during the summer months when thermal impact would be most critical. Figure 2.1-1 shows the location of the cooling towers for normal plant cooling on the ESP site. Figure 3.4-1 shows the proposed location of the intake structure and discharge structures for the new units. Figure 3.4-2 shows the general layout of the WHTF and North Anna Reservoir. Within the discharge channel, the blowdown discharge from Unit 3 would mix with the circulating water discharge from Units 1 and 2. The combined effluent streams would travel through the main ponds, connecting canals and side arms of the WHTF, while dissipating the excess heat through surface heat exchange to the atmosphere. Because of the significantly lower flow rate and heat content, the blowdown discharge from Unit 3 would have negligible effect on the thermal structure and heat dissipation capacity of WHTF. At the end of the WHTF, the combined flow, after losing a substantial amount of heat via heat exchange with the atmosphere, would return to the North Anna Reservoir through a 6-bay adjustable skimmer wall discharge structure at Dike 3 as described in Section 3.4.2. Upon entering the reservoir, most of the discharged cooling water would flow up-lake and would re-enter the intake structures after releasing more heat to the atmosphere.

The closed-cycle dry cooling tower system for new Unit 4 would consist of pumps that circulate cooling water in a closed loop at a rate of about 8.00×10^5 gpm (1782 cfs). The cooling water would be pumped through the main condenser and auxiliary heat exchangers, and then to the finned tubes of the dry cooling towers for heat dissipation to the atmosphere. Figure 2.1-1 shows the location of the cooling towers for normal plant cooling on the ESP site. The closed cycle dry towers for the circulating water and service water systems would be designed to dissipate the heat load of up to 1.03×10^{10} BTU/hr anticipated during full station load operation. During the heat transfer process, no water would be lost to the atmosphere since there would be typically no evaporation losses in a dry tower system. A small amount of make-up water on the order of 1 gpm (0.002 cfs) would be needed and would be obtained from North Anna Reservoir to replenish the evaporative loss only if an open pump sump with a free surface would be used to recirculate water in the circulating water system cooling water loop or the service water cooling loop. Water use impacts to Lake Anna would therefore be minimal. Since the dry cooling system would produce no continuous blowdown discharge, new Unit 4 would have no thermal impact on Lake Anna.

ER Section 3.4.1.2, Ultimate Heat Sink. The last sentence of this section is revised to reflect that the water supply to the storage basin would be pumped directly from the UHS make-up water pumps or other water supply pumps, instead of the service water pumps, installed in the new intake structures. ER Section 3.4.1.2 will be revised to read as follows:

For safety-related cooling, the UHS would provide cooling water to the reactor cooling systems and safety-related components that are necessary for the safe shutdown and cool-down of the plant under normal operations, anticipated operational events, and DBAs. Some reactor designs use a passive system and stored water for safety-related cooling and do not require an external UHS system to reach safe shutdown. For other reactor designs, a dedicated closed-cycle system with mechanical draft towers is proposed for the UHS. The UHS for each new unit would dissipate the decay heat of up to 1.2×10^8 BTU/hr during normal conditions and 4.2×10^8 BTU/hr during shutdown or accident conditions, in accordance with the PPE. The UHS system would consist of a pump house that circulates cooling water to the safety-related cooling systems and components at a rate of 58 cfs during normal conditions or 116 cfs during shutdown or accident conditions. Then the cooling water would flow to the UHS cooling towers where the excess heat would be dissipated to the atmosphere by evaporation and conduction. The UHS cooling towers would be designed for a temperature range of 16°F. According to the PPE, the evaporation water loss of each new unit is expected to be about 0.9 cfs during normal conditions and 1.9 cfs during upset or abnormal conditions. The blowdown flow from the UHS towers would be discharged to the new outfall at the head of the discharge canal and would have a flow rate varying from 0.3 cfs per unit during normal conditions to 1.9 cfs per unit during upset or abnormal conditions. An underground basin beneath each UHS tower, with a potential storage of 3.06×10^7 gallons of water, equivalent to 4.1×10^6 ft^3, would provide the 30-day supply of make-up water flow at 1.2 cfs to 3.8 cfs, the bounding rates from the PPE. Water supply to the storage basin would be pumped directly from the UHS make-up water pumps or other water supply pumps installed in the new intake structure.

ER Section 3.4.1.3.1, Station Load Factor. This section is revised to reflect the PPE rated unit heat load of $1.03x10^{10}$ Btu/hr for the combined circulating water and service water cooling systems of Unit 3. The once-through cooling system of Unit 3 is revised to reflect the use of closed-cycle dry and wet cooling tower system. ER Section 3.4.1.3.1 will be revised to read as follows:

The new units are expected to operate with a maximum load factor of 96 percent (annualized) considering scheduled outages and other plant maintenance. On a long-term basis, an average heat load of 9.9×10^9 BTU/hr per each new unit, that is 96 percent of the rated unit heat load of 1.03×10^{10} BTU/hr, would be dissipated to the atmosphere via wet and dry cooling towers for Unit 3 and the dry cooling towers for Unit 4.

ER Section 3.4.1.3.2, Condenser Inlet and Lake Water Temperature. This section is revised to reflect the new maximum condenser inlet temperature limit of 100°F for the design of the closed-cycle cooling system of the new units. The 1st paragraph of ER Section 3.4.1.3.2 will be revised to read as follows:

The new units' cooling systems would be designed for a maximum condenser inlet temperature limit of 100°F. This temperature is higher than the maximum allowable intake water temperature of 95°F for Units 1 and 2, specified in the existing units' Technical Requirements Manual. However, as the new units' closed-loop cooling systems operate independent of lake water temperature, no mandatory shutdown of the new units would be required if intake water temperature exceeded the 95°F limit.

ER Section 3.4.1.3.4, Anti-Fouling Treatment. This section is revised to reflect the need of water treatment for Unit 3's cooling tower make-up water that would come from the reservoir. The 1st paragraph of ER Section 3.4.1.3.4 will be revised to read as follows:

Bio-fouling control using thermal or chlorination treatment has not been used for the once-through cooling system (circulating water) of the existing units. Cooling tower make-up water for Unit 3 would come from the North Anna Reservoir and would require treatment for bio-fouling, scaling, and suspended matter, with acceptable biocides, antiscalants, and dispersants, respectively.

ER 3.4.2.1. Intake System. This section is revised to reflect the smaller intake flow rate supply for the make-up water and other plant water use of the closed-cycle combination dry wet cooling tower system of Unit 3, and to describe the reduced hydraulic dimensions and the invert elevation of the proposed shoreline pump intake structure. ER Section 3.4.2.1 will be revised to read as follows:

The intake structure for new units at the ESP site would meet Section 316(b) of the CWA and the implementing regulations, as applicable.

The new intake structure for Unit 3 would withdraw make-up water for the normal plant circulating water and service water cooling systems from the North Anna Reservoir at a flow rate up to 2.23×10^4 gpm (49.6 cfs). As presented in Section 3.4.1.1, make-up water for the closed-cycle dry cooling tower system of Unit 4 would not be required normally. However, if an open pump sump configuration would be used in the closed cooling water loop, a small amount of make-up water estimated to be on the order of 1 gpm (0.002 cfs) would be needed to replace the evaporative losses through the free surface of the sump. This make-up water for Unit 4 would be obtained from the North Anna Reservoir.

The intake system of the new units would consist of a compartmented intake structure with a common screen well and separate pump bays dedicated to each unit, and a common approach channel in a cove on the south shore of the North Anna Reservoir near Harris Creek and immediately west of the cove that houses the existing intake structure. In addition to the make-up water pumps for Unit 3's closed-cycle cooling towers, the new intake structure would also house a number of smaller pumps with a total capacity of up to 11 cfs per unit to supply other plant water uses, including 1.2 to 3.8 cfs of make-up water for the UHS storage system, 1.2 cfs to 1.6 cfs of demineralized water, and a maximum of 5.6 cfs of fire protection water. Screen wash pumps with a total capacity of about 1.1 cfs per unit will be installed in the screenwell to clean the traveling water screens during operation of the intake pumps. The screen wash flow would not be a consumptive water use as it would be recirculated back to intake flow upstream of the traveling water screens. The miscellaneous water supply pumps in the Unit 4 pump bays would also supply the make-up water as needed to the closed cooling water loop of the Unit 4 dry cooling tower system. The location of the new intake is shown in Figure 3.4-1. Figure 3.4-3 is a schematic drawing showing the approximate footprint and dimensions of the new intake structure and the intake channel.

As shown in Figure 3.4-3, the intake channel and new combined intake structure are in the cove originally planned for the intake of the abandoned Units 3 and 4. In the early 1980s, a cofferdam was installed across the cove to facilitate the construction of the now-abandoned intake system. To bring water from the reservoir to the new intake structure via the approach channel, the cofferdam, or a portion of it, would be removed.

Because of the limited quantity of water to be supplied from the North Anna Reservoir, no major modification to the existing shoreline or dredging in the approach channel would be necessary. The approach channel has a typical side slope of 3:1 (horizontal to vertical) on both sides and a bottom width varying from about 300 feet at the lake end to 230 feet at the entrance to the screenwells and pump bays. The invert elevation of the channel is approximately 220 ft msl. At the minimum lake operating level (242 ft msl) for the future combined operation of the new and existing units, the flow velocity in the approach channel would be about 0.01 fps, based on the intake flow rate of 61 cfs for Unit 3 and 11 cfs for Unit 4. If a partial opening at the cofferdam would be constructed to connect the reservoir with the approach channel of the intake structure of Units 3 and 4, the through flow velocity at the opening would be designed to be about 0.1 fps, similar to the current velocity in the reservoir, to reduce entrainment of debris, aquatic life and sediment.

At the end of the approach channel, lake water would flow into the common screen well and the pump bays of either Unit 3 or Unit 4 at a velocity of less than 1 fps. A skimmer wall, extending to just below Elevation 242 ft msl, would be installed at the entrance of the screen well to reduce the amount of floating debris carried into the intake. The screen well would also be equipped with automatically raking trash racks, traveling water screens, debris basin, and screen wash pumps. The traveling water screens would be designed to have the capability to operate continuously.

Debris collected by the trash racks and the traveling water screens would be collected in a debris basin for cleanout and disposal as solid waste. Downstream of the common screen well, multiple pump bays would house the make-up water pumps for Unit 3. Other smaller capacity water supply pumps and firewater pumps of Unit 3 would also share the space in some of these pump bays. The make-up water pumps and firewater pumps for Unit 4 would be located in separate pump bays dedicated to Unit 4. To enhance the performance of the debris-filtering system and minimize fish mortality due to impingement and entrainment, the intake structure would be sized so that the designed approach velocity to the screen well, trash racks, and traveling water screens would be less than 1 fps at the minimum operating lake level of 242 ft msl. The total width of the intake structure would be about 70 feet wide, with approximately 50 feet allocated for Unit 3 and 20 feet for Unit 4. A bottom sill would be installed at the entrance of the common screenwell to reduce entrainment of bed sediment. Figure 3.4-4 is a schematic section view of the arrangement of the intake structure. The shoreline area disturbed by the construction of the new intake structure would be stabilized and rip-rap protected against erosion. The intake systems for the new units would be located inside a restricted area marked by no-boat buoys to prohibit public access, as are the existing units.

ER Section 3.4.2.2, Discharge System. This section is revised to reflect the smaller cooling system discharge of blowdown flow to the WHTF from the closed-cycle dry and wet cooling tower system of Unit 3. The long-term average inflow to the lake and flow released at the dam is also revised. The 1st, 2nd, and 7th paragraphs of ER Section 3.4.2.2 will be revised to read as follows:

The blowdown flow from the closed-cycle cooling towers of Unit 3 would be released into the discharge channel of the WHTF via a new outfall. The temperature of the blowdown discharge would be no greater than 100°F. Figure 3.4-5 shows the location of the future outfall in relation to the existing outfall of Units 1 and 2. In accordance with the Table 3.3-1, the maximum blowdown flow rate from the circulating water and service water cooling towers of Unit 3 would be no greater than 12.4 cfs. As presented in Section 3.4.1.1, there would be no blowdown discharge from the closed-cycle dry cooling tower system for Unit 4.

With all four units operating, the 12.4 cfs of blowdown effluent from Unit 3 would mix in the discharge channel with 4246 cfs of circulating water from Units 1 and 2. During the UHS cooling mode, a very small blowdown flow of about 0.3 to 1.9 cfs per new unit would be discharged to the outfall. Other plant discharges and miscellaneous drains from each new unit to the WHTF would total about 0.8 cfs to 1.1 cfs.

After entering the North Anna Reservoir, most of the cooling water flow up-lake toward the intake for re-circulating back to the plant cooling system. A small portion of the discharge flow is released at the dam into the North Anna River downstream. As presented in Section 5.3.1.1, the long-term average flow released at the dam is estimated to be 276 cfs during the operation of the existing units. The lake receives inflow estimated to be about 369 cfs on a long-term average basis. At the normal pool level of 250 ft msl, the North Anna Reservoir has a surface area of 9600 acres, a volume of 1.06×10^{10} ft^3, and an average depth of 25 feet (Reference 1). The maximum depth is 70 feet near the dam.

ER Section 3.4.2.3, Heat-Dissipation System. This section is revised to reflect the use of closed-cycle combination dry and wet cooling tower system for the circulating water system and closed-cycle wet towers for the service water cooling system of Unit 3. The dry tower system description for Unit 4 is also revised. The 1st and 3rd paragraphs of ER Section 3.4.2.3 will be revised to read as follows, and the 2nd paragraph will be deleted:

The cooling system described in Section 3.4.1 would provide the normal heat sink for Unit 3. A closed-cycle, combination dry and wet cooling tower arrangement would be used for the circulating water system. A separate, service water cooling system would utilize a closed-cycle wet cooling tower for dissipation of waste heat from auxiliary heat exchangers not cooled by the plant circulating water system. Mechanical draft type dry towers with electric motor driven fans would be used to force airflow across the finned tubes to increase heat rejection to the atmosphere. Similarly, mechanical draft type wet towers with electric motor driven fans would be used to force airflow through the sprayed water to increase heat rejection to the atmosphere. The closed-cycle cooling towers will be designed to dissipate up to 1.03×10^{10} BTU/hr of waste heat at full station load.

For the closed-cycle cooling system of Unit 4, dry cooling towers with finned tubes would be used as the normal heat sink. Mechanical draft type dry towers with electric motor driven fans would be used to force airflow across the finned tubes to increase heat rejection to the atmosphere. The dry cooling towers would be designed to dissipate a maximum waste heat load of up to 1.03×10^{10} BTU/hr.

ER Figure 3.4-3, Layout of Screenwell/Pump Intake for New Units 3 and 4. This figure shows the smaller screenwell/pump intake footprint for the closed-cycle dry and wet tower system of Unit 3. ER Figure 3.4-3 will be revised as follows:

[See next page]

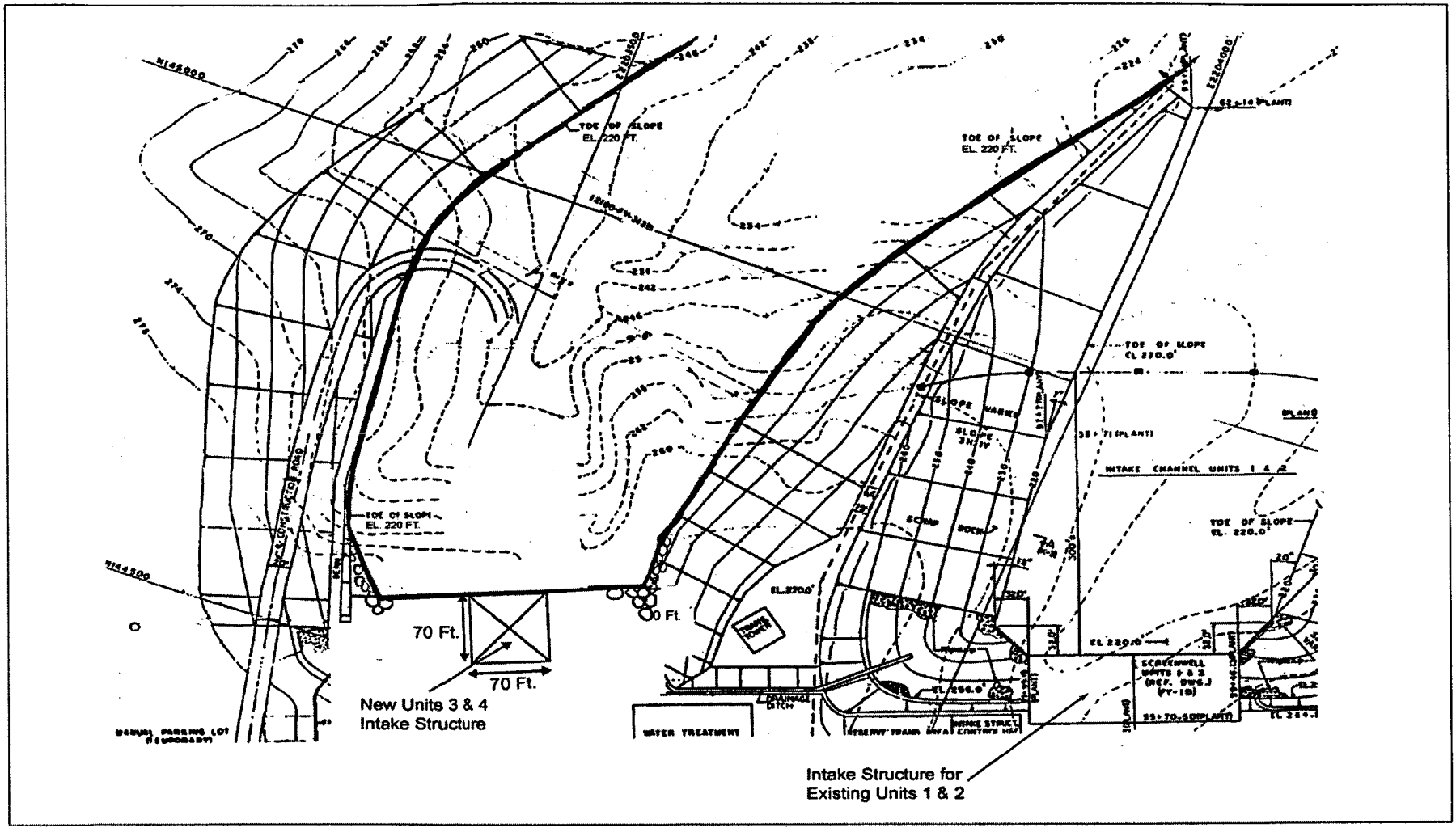


Figure 3.4-3 Layout of Screenwell/Pump Intake for New Units 3 and 4

ER Figure 3.4-4, Schematic View of Pump Intake. This figure shows that make-up water pumps, instead of circulating water pumps, would be installed in the pump intake. ER Figure 3.4-4 will be revised as follows:

[See next page]

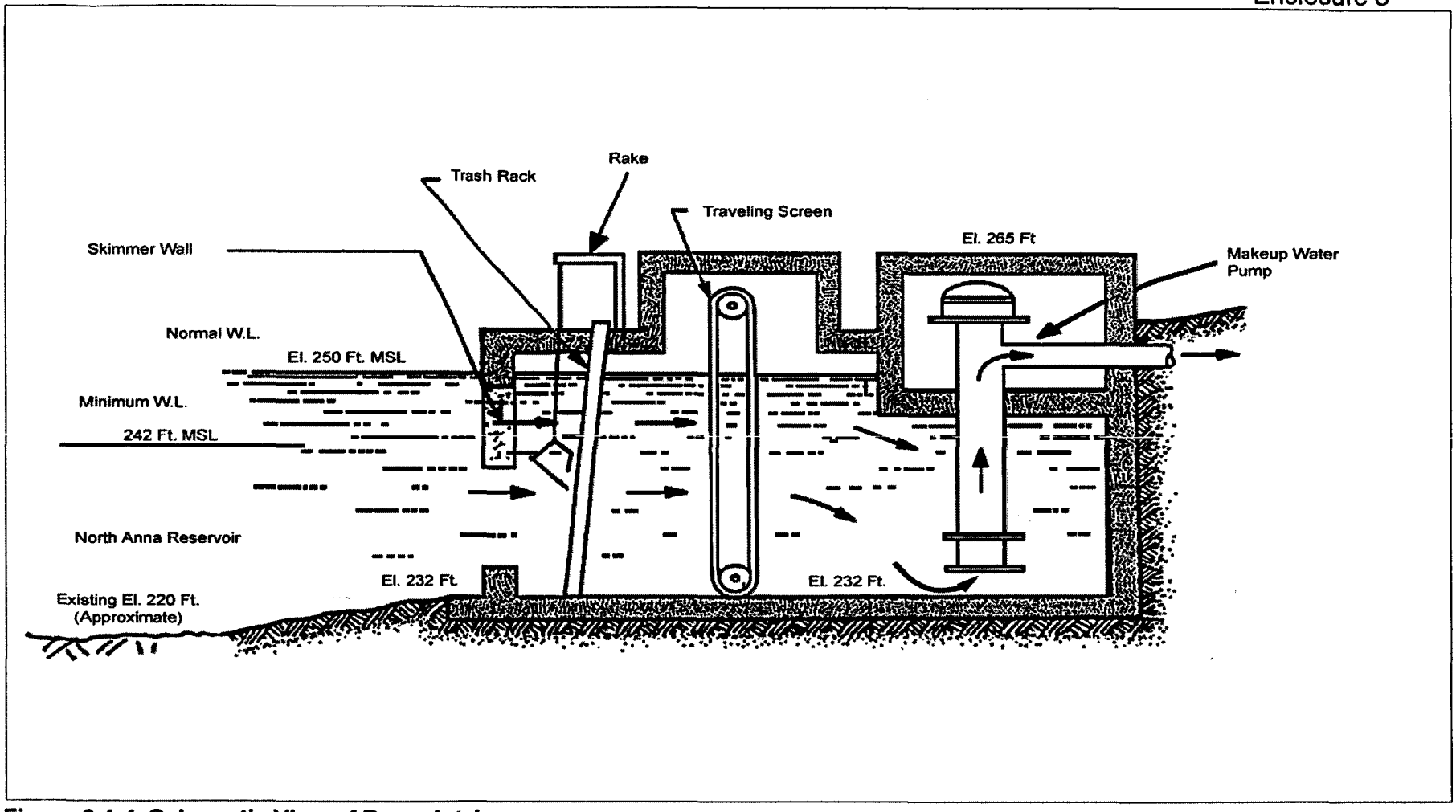


Figure 3.4-4 Schematic View of Pump Intake

ER Figure 3.4-7, Schematic Diagram of the Discharge System. This shows that cooling tower blowdown from the closed-cycle system of Unit 3 would be discharged via the new outfall in the discharge canal. ER Figure 3.4-7 will be revised as follows:

[See next page]

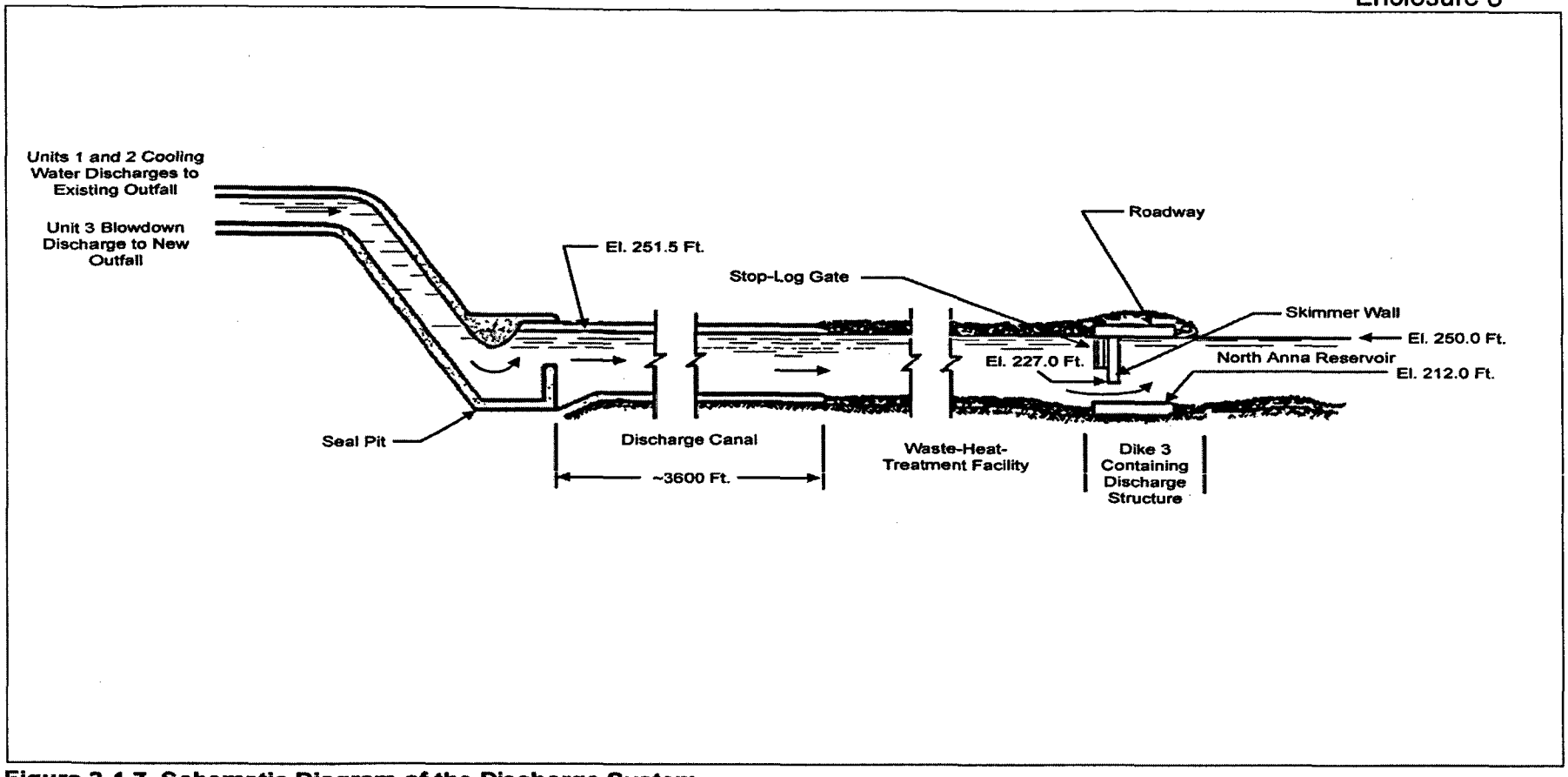


Figure 3.4-7 Schematic Diagram of the Discharge System

ER Section 3.6.1, Effluents Containing Chemicals or Biocides. This section is updated to identify chemicals and biocides that will be part of the effluents from Unit 3 discharged to the Lake Anna reservoir based on the combination dry and wet cooling tower system. ER Section 3.6.1 will be revised to read as follows:

Proper water chemistry for plant operation incorporates the treatment of water used in various secondary systems. Consequently, effluents from these water systems in the new units would be treated but may still contain some low level chemicals and/or biocides, similar to effluents from the existing units. These effluents would be treated according to regulations, as current discharges. The following list identifies some typical chemicals that may be present in the plant's permitted discharge:

- Iron
- Chlorides
- Ammonia or Amines
- Hydrazine
- Phosphates or dispersants used in cooling towers
- Low levels of Oil and Grease
- Corrosion Inhibitors used in cooling systems
- Suspended solids

Discharges would occur from domestic water treatment, dry and wet cooling tower treatment, and plant blowdown. Regardless of the water systems' sources or constituents, each constituent discharged to the environment would be limited (i.e., volume and concentration) by the VPDES permit (Reference 1).

ER Section 3.7.1, Switchyard Interfaces. This section is revised to reflect the higher electrical output of the ESBWR design. The 4th paragraph of ER Section 3.7.1 will be revised to read as follows:

The existing high-voltage equipment in the bay is rated for 3000A and 40 kA, and the 5-inch tubular bus is rated for 3676A and a 2 fps wind. The addition of the new units would require the upgrading of both the existing equipment and the bus, due to an increased output of approximately 3040 MWe. The specific upgrading would be determined based on detailed system studies and would be described in the COL application.

ER Section 3.7.2, Transmission System. This section is revised to reflect the higher electrical output of the ESBWR design. The 2nd, 3rd and 4th paragraphs of ER Section 3.7.2 will be revised to read as follows:

Each transmission line, constructed between 1973 and 1984, occupies a separate right-of-way. The rights-of-way range in width from 37 to 84 meters (120 to 275 ft) and from 24 to 66 km (15 to 41 miles) in length, covering a total of approximately 1174 ha (2900 acres) (Reference 1). The capacity of the 500 kV transmission lines is such that the output of the existing units can be carried by any of the 500 kV lines. Units 1 and 2 were uprated in 1986 to a gross electrical output of 1964 MWe, with a net electrical output of approximately 1884 MWe (Reference 2). The net electrical output of the new units is estimated to be 3040 MWe. The existing 500 kV transmission line utilizes 2 x 2500 ACAR (aluminum conductor aluminum reinforced) 84/7 conductors per phase and is rated 2292 MWe with a 2 fps wind. The 230 kV line can carry approximately 571 MWe due to the size of the transformer.

Total output of the existing units and the new units would be:

1884 MWe + 3040 MWe = 4924 MWe

Capacity of any two 500 kV lines and a 230 kV line is:

(2 × 2292 MWe) + 571 MWe = 5155 MWe

Thus, based on this initial evaluation, any two 500 kV transmission lines and the 230 kV transmission line are expected to have sufficient capacity to carry the total output of the existing units and the new units. However, detailed system load flow studies for the new units cannot be performed until an in-service date for the new units is established.

ER Section 3.8.1, Light-Water-Cooled Reactors. This section is revised to reflect the higher thermal and electrical output of the ESBWR design. The 5th and 7th paragraphs of ER Section 3.8.1 will be revised to read as follows:

The LWR technologies being considered are the ABWR, the ESBWR, the AP-1000 (Advanced Passive PWR), the IRIS, and the ACR-700

(Advanced CANDU Reactor). The standard configuration for each of these reactor technologies is as follows. The ABWR is a single unit, 4300 MWt, nominal 1500 MWe reactor. The ESBWR is a similar BWR: single unit, 4500 MWt, nominal 1520 MWe. The AP-1000 is a single unit, 3400 MWt, nominal 1117–1150 MWe PWR. The IRIS is a three module PWR configuration for a total of 3000 MWt and nominal 1005 MWe. The ACR-700 is a twin unit, 3964 MWt, nominal 1462 MWe, LWR with a heavy water moderator.

10 CFR 51.52(a)(1) requires that the reactor have a core thermal power level not exceeding 3800 MW. Of the considered LWR technologies, only the two BWRs, the ABWR and the ESBWR, exceed this value. The ABWR has a core thermal power level of 4300 MW thermal (MWt) while the ESBWR reactor power level is 4500 MWt. The core power level was established as a condition because, for the LWRs being licensed when Table S-4 was promulgated, higher power levels typically indicated the need for more fuel and therefore more fuel shipments than was evaluated in Table S-4. This is not the case for the new LWR designs due to the higher unit capacity and higher burnup for these reactors. The annual fuel loading for the reference reactor was 35 MTU while the annual fuel loading for both the ABWR and ESBWR is only 32.8 MTU. In fact, the annual MTU of fuel normalized to equivalent electrical generation is just slightly more than half of the reference LWR, 18.4 versus 35. This reduced annual MTU of fuel would mean fewer shipments and less environmental impact. Also, WASH-1238 states: "The analysis is based on shipments of fresh fuel to and irradiated fuel and solid waste from a boiling water reactor or a pressurized water reactor with design ratings of 3,000 to 5,000 MW thermal (MWt) or 1,000 to 1,500 MW electrical (MWe)." Both the ABWR and the ESBWR fall within the thermal power ratings as listed. The slight deviation from maximum listed electrical output due to a higher thermal efficiency has no impact on the analysis.

ER Table 3.8-1, LWR-S4 Transportation Impact Evaluation. This table is revised to show the higher reactor power level and average burnup of the ESBWR. The ESBWR column of ER Table 3.8-1 will be revised to read as follows:

[See next page]

Reactor Technology	Table S-4 Condition	ESBWR (Single unit) (4500 MWt) (1520 MWe)	ABWR (Single unit) (4300 MWt) (1500 MWe)	AP-1000 (Single Unit) (3400 MWt) (1117–1150 MWe)	IRIS (3 Reactors) (3000 MWt total) (1005 MWe total)	ACR-700 (Twin Unit) (3964 MWt total) (1462 Mwe total)
Reactor Power Level (MWt)	not exceeding 3800 per reactor	4500	4300	3400	3000 (1000 per reactor, 3 reactors per plant)	3964 (1982 per reactor, 2 reactors per plant)
Average burnup (MWd/MTU)	Not exceeding 33,000; NRC has also accepted 62,000 for peak rod as bounded	45,000-55,000	46,000	48,700	55,200	20,500

ER Section 4.1.1.6.2, Water Courses and Wetlands. This section has been revised to better describe the wetlands within the ESP site. ER Section 4.1.1.6.2 will be revised to read as follows:

A few small wetland areas and two intermittent streams exist on the ESP site (refer to Section 2.4.1). Watercourses and wetlands would be avoided to the extent possible during any construction. Any work that has the potential to impact a wetland would be performed in accordance with the applicable regulatory requirements and necessary mitigation strategy. Therefore, construction-related impacts would be small.

ER Section 4.2.1.1, Surface Water. This section is revised to reflect the make-up water function of the intake structure. The 5th paragraph of ER Section 4.2.1.1 will be revised to read as follows:

The make-up water intake for the new Unit 3 would be located along the shoreline of the North Anna Reservoir west of the intakes for the existing units. A cofferdam installed in the early 1980s for the construction of the intake for the abandoned Units 3 and 4 exists at this location. Construction of the intake for the new Unit 3 would require dewatering. Because of the cofferdam, the intake location is not in contact with the North Anna Reservoir. Therefore, construction of the shoreline intake could proceed without any hydrologic impacts to the North Anna Reservoir. State-approved BMPs would be implemented prior to construction of the intake to reduce the impacts of erosion and sedimentation.

ER Section 4.3.1.2, ESP Site. This section has been revised to better describe the wetlands within the ESP site. The 3rd paragraph of ER Section 4.3.1.2 will be revised to read as follows:

A few small wetland areas and two intermittent streams exist on the ESP site (refer to Section 2.4.1). Watercourses and wetlands would be avoided to the extent possible during any construction. Any work that has the potential to impact a wetland would be executed in accordance with the applicable laws, regulations, permits, and authorizations. Therefore, construction-related impacts would be small.

ER Section 4.3.2, Aquatic Ecosystems. This section is revised to address the aquatic effects of constructing a smaller intake structure and cooling towers. The 1st, 2nd, 3rd, 5th, and 11th paragraphs of ER Section 4.3.2 will be revised to read as follows:

Construction of an intake structure would be the primary source of construction impacts on the aquatic environment. Construction would involve major modifications to an existing intake structure. Section 3.4.2 provides a description of the proposed construction activities.

The new intake structure would be approximately 70 feet long and 70 feet wide and would house the trash racks, traveling screens, and intake pumps (Figure 3.4-3 and Figure 3.4-4). No major modifications to the shoreline or short intake channel are expected, except that the existing cofferdam would be removed to allow reservoir water access to the new intake through the intake channel that is now behind the cofferdam.

Approximately 84,000 cubic yards of material would be moved from the cofferdam. All of the material would be properly disposed of in accordance with regulatory requirements and permit conditions.

Degraded water quality (e.g., increased turbidity and siltation) as a result of removal of the cofferdam and construction of the intake would pose the greatest potential for impacts on the North Anna Reservoir ecosystem in the immediate vicinity of the construction activities. Construction activities would result in the temporary loss of benthic habitat and the displacement or loss of benthic organisms, which provide food for other animals such as fish and shorebirds. After construction, the intake channel and cove would be re-colonized by benthic organisms available to predators. To minimize impacts to benthic populations in the reservoir, intake construction and protection activities would be conducted in accordance with state regulations and permit requirements. The benthic habitat lost would be temporary and a small percentage of the available benthic habitat. The loss of this habitat would not have a long-term impact on the aquatic ecosystem.

Construction of cooling towers could be near an intermittent stream (Figure 3.4-3). See Section 4.3.1 for additional discussion. Construction could result in soil erosion and silt entry into the stream.

ER Section 4.3.2.1, Construction Implications of Options to Mitigate Increased Lake Temperature. This section is no longer applicable.

ER Section 4.3.2.1 will be deleted.

ER Section 5.1.1, The Site and Vicinity. This section is revised to identify heat and moisture dissipation from the wet towers as a potential land-use impact to the vicinity from the new units. ER Section 5.1.1 will be revised to read as follows:

Section 2.2.1 describes the NAPS site and vicinity. The NAPS site (including the EAB) has been zoned by Louisa County for industrial use. Land-use impacts to the ESP site as a result of operating the new units would not be significant to the region. Potential land-use impacts to the vicinity from the new units may occur as a result of the following:

- Additional discharges through the WHTF
- Heat dissipation from the dry towers
- Heat and moisture dissipation from the wet towers
- Increased traffic loads on the existing local transportation network

ER Section 5.1.1.1, Waste Heat Treatment Facility Discharges. This section is revised to identify that the expected increase in discharge volume to WHTF and the resultant increase in WHTF temperature from Unit 3 wet cooling tower system blowdown would be negligible when compared with the discharges from the existing units. The 2nd paragraph of ER Section 5.1.1.1 will be revised to read as follows:

All discharges to the WHTF due to operations would continue to be in accordance with federal, state, and local laws and regulations and applicable permit requirements (e.g., VPDES Permit). State agencies (e.g., VDEQ) conduct regular inspections and advise Virginia Power of any concerns or problems that require resolution. The expected increase in discharge water volume from Unit 3 wet cooling tower system blowdown would be negligible when compared with the discharge water volume from the existing Units. The change in temperature at the discharge point of the WHTF due to operation of the new units would be negligible and would not impact the current or future recreational uses of the lake.

ER Section 5.1.1.2, Heat Dissipation for Dry Towers. This section is revised to describe the heat transfer mechanism of the wet and dry towers and to reference a discussion of fogging, icing, and salt deposition. The title and content of ER Section 5.1.1.2 will be revised to read as follows:

5.1.1.2 Heat and Moisture Dissipation for Dry and Wet Towers

Potential impacts on land use would be related to possible increases in local temperatures due to heat dissipation to the atmosphere from the new dry and wet towers. A closed-cycle, combination dry and wet tower cooling system would be used for Unit 3 and a dry tower cooling system alone would be used for Unit 4. Section 3.4.1.1 contains a detailed description of the operation of the wet and dry towers. As ambient air is drawn over sealed piping containing heated water in dry towers, excess heat is transferred to the air through conduction and convection. In wet towers, heat from the water is transferred to the air by allowing a small portion of the water to evaporate thus raising the air temperature and relative humidity. The heated air from the dry and wet towers is then released to the atmosphere where it mixes and is entrained into the surrounding air mass. Any increases in overall atmosphere temperature would be very localized to the NAPS site, and would not affect the atmospheric or ground temperatures beyond the NAPS site boundary. Therefore, there would be no impacts to offsite land use due to heat dissipation to the atmosphere from the new dry and wet towers for Units 3 and 4. Fogging, icing, and salt deposition, which could result from the moisture dissipation from the wet towers, are discussed in Section 5.3.3.

ER Section 5.2.1, Hydrologic Alterations and Plant Water Supply. This section is revised to describe the use of a closed-cycle combination dry and wet cooling tower system for Unit 3 and to identify the make-up water source. The 2nd and 3rd paragraphs of ER Section 5.2.1 will be revised to read as follows:

As described in Section 3.3.1, the North Anna Reservoir would supply most water needs during operation of the new units, which include plant cooling, the initial fill and make-up water for the UHS cooling tower, water supply to the demineralized water system, and fire protection water. Most of the water needs would be for plant cooling. Unit 3 would use a closed-cycle system for plant cooling and a combination of dry and wet cooling towers for heat dissipation. Make-up water to replace the water lost due to evaporation in the wet cooling towers would be supplied from the North Anna Reservoir. Unit 4 would use a closed-cycle system for plant cooling and dry cooling towers for heat dissipation. There would typically be no make-up water needs since the cooling water would be circulated in a closed loop from the surface condenser to the dry towers of Unit 4. In the event that the Unit 4 cooling water loop would use an open pump sump configuration with a free surface, a small amount of make-up water estimated to be on the order of 1 gpm (0.002 cfs) would be needed to replenish the evaporative loss. This make-up water would be obtained from the North Anna Reservoir. There would be no blowdown discharge from the Unit 4 dry cooling towers.

Water needs other than for plant cooling would be required on an intermittent, short-term basis and would be small relative to the long-term plant water use for normal cooling of Unit 3. The water needs supplied by Lake Anna would include UHS cooling tower make-up, demineralized water supply, and fire protection water supply, as described Section 3.3.1. Based on information provided in Table 3.3-1 and Table 3.3-2, withdrawals would total 2.5 cfs during normal plant operation and 11.0 cfs during abnormal or upset conditions for each unit. Plant water releases back to the lake via the Waste Heat Treatment Facility are described in Section 3.3.1. These releases would total 1.1 cfs during normal plant operation and 3.0 cfs during abnormal or upset conditions for each unit, based on information provided in Table 3.3-1 and Table 3.3-2. Considering these withdrawals and returns, the net use of Lake Anna water for each of the new units would be 1.4 cfs during normal plant operation and up to 8.0 cfs during upset or abnormal conditions. Because the 1.4 cfs value (2.8 cfs for two new units) is small relative to the other terms in the Lake Anna water balance and because water consumption at this rate would occur on an intermittent, short-term basis, this water usage would have no impact on the adequacy of the water supplies to meet plant water needs.

ER Section 5.2.1.1, Operational Activities That Could Result in Hydrologic Alterations. This section is revised to describe the operation of the closed-cycle, dry and wet cooling tower system for proposed Unit 3, and to list the make-up withdrawal, evaporation, and blowdown discharge rates for the wet cooling towers. The 2nd paragraph of ER Section 5.2.1.1 will be revised to read as follows:

The operation of Unit 3 would result in evaporative losses from the wet cooling towers used for plant cooling. Table 3.3-1 indicates Maximum Water Conservation (MWC) mode and Energy Conservation (EC) mode evaporation rates of 25.7 and 37.2 cfs, respectively. To maintain the water balance in the closed-cycle cooling system, water supplied from the North Anna Reservoir would be used to make up the water lost to evaporation. Table 3.3-1 indicates the maximum make-up water withdrawal rate of 34.3 cfs for an MWC mode and 49.6 cfs for an EC mode, which includes evaporation, drift losses, and blowdown requirement. These make-up withdrawal rates are in addition to the 4246 cfs of cooling water withdrawn currently by the existing units (Reference 1). Blowdown from the wet cooling towers would be returned via the WHTF to the North Anna Reservoir. MWC mode and EC mode blowdown rates are 8.6 and 12.4 cfs, respectively, as is indicated in Table 3.3-1. The rates expressed for evaporation, make-up, and blowdown are maximums for the defined modes of operation, and would occur on an instantaneous basis only when maximum dry and wet bulb ambient conditions are at their defined 0.4% exceedance condition. The average evaporative loss during normal plant operation is expected to be 18.5 cfs based on the operating plan described in Section 3.4.1.1.

ER Section 5.2.1.2, Hydrologic Alterations and Effects on Other Users. This section is revised to quantify the impact of operating Unit 3's closed-cycle, dry and wet cooling tower system on releases from the North Anna Dam. ER Section 5.2.1.2 will be revised to read as follows:

The additional water use would reduce the volume of water available for release from the North Anna Dam. Evaporation from Unit 3's wet cooling towers would decrease the water available to be released from the dam by a maximum of 25.7 cfs during MWC mode operating conditions and 37.2 cfs during EC mode operating conditions on an instantaneous basis. The operation of the Unit 4 closed-cycle dry cooling system would have no measurable impact on the quantity of water available for dam release. No reductions in the minimum releases specified in the Lake Level Contingency Plan (Reference 2) would occur.

Additional effects of the hydrologic alterations would be reductions in the Lake Anna water levels during periods of extended drought, due to the additional evaporative losses associated with the operation of Unit 3's wet cooling towers. The impacts on lake level from the operation of the new units are presented in Section 5.2.2.

No hydrologic alterations in addition to those identified and analyzed above are anticipated.

ER Section 5.2.1.3, Proposed Practices to Minimize Hydrologic Alterations Having Adverse Impacts. This section is revised to describe how the operating modes of the Unit 3 would be used to reduce adverse impacts on lake levels and reservoir releases during sustained dry periods. ER Section 5.2.1.3 will be revised to read as follows:

As described in Section 3.4.1.1, the closed-cycle, dry and wet tower cooling system for normal plant cooling of Unit 3 would be operated to conserve water when lake inflows are insufficient to maintain a pool level of 250 ft or above. When lake levels fall below 250 ft msl and the level is not restored within a reasonable period of time (e.g., 7 days), the cooling system could be operated in a Maximum Water Conservation (MWC) mode. In this mode, only the dry tower would be used to dissipate the entire heat load from the surface condenser when the ambient dry bulb temperature is sufficiently low. When the ambient dry bulb temperature is above the temperature where the dry tower can reject the plant waste heat on its own, the necessary capacity of wet tower cells required to assist in the dissipation of condenser heat load would be placed in operation in series with the dry tower. The use of the MWC mode would reduce adverse impacts on lake levels and reservoir releases during sustained dry periods.

ER Section 5.2.1.4, Comparison of Plant Water Needs to the Availability of Water Supplies. This section is revised to compare the plant water needed by Unit 3's closed-cycle, dry and wet cooling tower system to available water supply. ER Section 5.2.1.4, including Table 5.2-1, will be revised to read as follows:

The available water supplies are compared to plant water needs on a time-averaged basis in Table 5.2-1. The available water supply is estimated from the water balance equation:

Available Water Supply = Net Inflow – Evaporation – Minimum Release (Equation 5.2-1)

where:

Net Inflow = average net inflow to Lake Anna from tributary inflow, groundwater discharge, and direct precipitation;

Evaporation = average pre-operational evaporation, including natural evaporation and forced evaporation from the existing units; and

Minimum Release = minimum amount of flow that must be released from the North Anna Dam.

Table 5.2-1 summarizes the results for the combined operation of the existing units plus new Unit 3 using a closed-cycle, combination dry and wet cooling tower system. The results would be similar to the combined operation of the existing units plus new Unit 3 using a closed-cycle, combination dry and wet cooling tower system along with new Unit 4 using a closed-cycle, dry cooling tower system with no or negligible make-up water needs. The average evaporative loss from Unit 3's wet cooling towers is used to define the plant water needs on a long-term operating basis. The results provided in Table 5.2-1 indicate that the available water supply (236 cfs) exceeds the plant water needs (18.5 cfs).

Table 5.2-1 Available Water Supply Versus Plant Water Needs

Quantity	Flow Rate (ft^3/s) Existing Units Plus Units 3 & 4
Net Inflow[a]	369
Pre-Operational Evaporation[b]	93
Minimum Release[c]	40
Available Water Supply[d]	236
Plant Water Needs[e]	18.5

a. Average net inflow derived from water balance model described in Section 5.2.2.

b. Natural evaporation from Lake Anna plus forced evaporation from the existing units on a time-averaged basis; derived from the thermal model described in Section 5.3. Forced evaporation is based on a 93% plant capacity factor.

c. Minimum release for Lake Anna water levels in excess of 248 ft above mean sea level (Reference 2).

d. Equation 5.2-1

e. Average evaporation associated with Unit 3's wet cooling towers based on a 96% plant capacity factor; the evaporation rate was derived from the water balance model described in Section 5.2.2. Unit 4's dry towers incur no to negligible evaporative losses.

ER Section 5.2.2.1.1 Model Formulation. This section is revised to reflect the evaporative losses of Unit 3's wet cooling towers in the water balance model. Equation 5.2-4 in the 4th paragraph of ER Section 5.2.2.1.1 will be revised to read as follows:

The outflow rate from Lake Anna, O, is defined as

$$O \equiv O_{Preop\text{-}Evap} + O_{Unit3\text{-}Evap} + O_R \qquad \text{(Equation 5.2-4)}$$

where:

$O_{Preop\text{-}Evap}$ is the pre-operational outflow due to evaporation
$O_{Unit3\text{-}Evap}$ is the evaporative loss associated with Unit 3's wet cooling towers
O_R is the outflow from dam releases

ER Section 5.2.2.1.2, Model Input Data. This section is revised to reflect the use of a revised storage-elevation curve for the Lake Anna, describe the process for estimating evaporation rates from existing Units 1 and 2 and new Unit 3, and describe the operating modes for Unit 3's closed-cycle, dry and wet cooling tower system. ER Section 5.2.2.1.2, including Table 5.2-2, will be revised to read as follows:

Required model input includes the relationship between water surface elevation and lake storage, the relationship between water surface elevation and lake outflow, the inflow time history to Lake Anna, and the time histories of evaporative losses from the lake and the wet cooling towers. The bases for assigning these input data are described below.

The relationship between water surface elevation and storage is derived from the elevation-volume curves for the North Anna Reservoir and the WHTF, which are reported in the UFSAR for the existing units (Reference 1, Appendix 2A). These curves have been added to yield a single elevation-storage curve for the entire Lake Anna for the purpose of this water balance study. Table 5.2-2 summarizes the storage volumes determined at elevations 240, 250 and 260 ft msl. A quadratic equation was fitted to the values for interpolating between elevations.

Table 5.2-2 Data Input for Water Balance Model

Elevation (ft msl)	Storage (acre-feet)		
	North Anna Reservoir	WHTF	Total Lake Anna
240	161,900	33,300	195,200
250	244,300	60,800	305,100
260	352,750	105,300	458,050

The operating rule curve implemented in the model, which relates water surface elevation to dam releases, has been developed as follows. For lake levels less than or equal to the normal pool elevation of 250 ft above msl, the Lake Level Contingency Plan is followed (Reference 2). This plan requires a minimum instantaneous release from the Lake Anna impoundment of 40 cfs. When lake level drops to or below 248 ft msl, releases can be incrementally reduced to a 20 cfs minimum. For lake levels greater than or equal to 250.1 ft msl, it is assumed that any inflow in excess of the evaporative losses is released, provided the minimum release requirements are met.

The inflow time history to Lake Anna has been calculated by a reverse routing procedure using observed Lake Anna releases and water levels and estimated pre-operational evaporation. This procedure has been adopted because only a small fraction of the Lake Anna watershed is gauged, as is described in Section 2.3.1. The inflow to Lake Anna is calculated by solving Equation 5.2-5 for I_n, or:

$$I_n = \frac{S_{n+1} - S_n}{\Delta t} + O_n \quad \text{(Equation 5.2-7)}$$

This calculation requires the time histories for storage, *S*, and outflow, *O*. The storage time history has been determined using the available period of record for lake level observation, which extends from October 1, 1978, through April 10, 2003. Lake levels, *h*, have been related to *S* through quadratic interpolation of the values summarized in Table 5.2-2. According to Equation 5.2-4, *O* includes the historical releases from the North Anna Dam, and the historical rate of Lake Anna evaporation associated with operation of the existing units. Historical releases from the dam from October 1, 1978, through October 9, 1995, have been derived from the Partlow stream gauging station, which is located approximately one-half mile downstream of the dam. Stream gauging at this station was discontinued on October 10, 1995. Releases from October 10, 1995, through April 10, 2003 have, therefore, been estimated from the historical gate openings and associated rating curves for the North Anna Dam. The determination of historical lake evaporation is described below.

Historical evaporation from Lake Anna has been estimated using the Lake Anna Cooling Pond Model developed by the Massachusetts Institute of Technology (Reference 4, Reference 5). This model calculates, as part of the heat balance, the heat lost to the atmosphere due to evaporation and the associated evaporation rate on a daily basis for the control volumes used to represent the main ponds in the WHTF and the North Anna Reservoir. The thermal model also includes a number of side arms for which the model does not provide the evaporation rates directly. To determine these evaporation rates, an exponentially decreasing function is used to represent the temperature distribution in the surface layer of each side arm based on the entrance and return flow temperatures predicted by the thermal model. Using the mean value of this function to assign a characteristic temperature for the entire side arm, side arm evaporation is calculated using the Ryan-Harleman function (Reference 6). The pre-operational evaporative loss, $O_{Preop\text{-}Evap}$, is then determined as the sum of the values calculated directly by the thermal model for the ponds and

those calculated for the side arms. Note that this time series has been estimated using the historical waste heat load from the existing units.

For predictive purposes, the evaporative losses associated with the existing units, which use once-through cooling systems, have been determined on a daily basis using the thermal model following the methodology described above. The calculated evaporation rates have been corrected to reflect a 93 percent plant capacity factor for the existing units and averaged to obtain weekly values for use in the water budget model. The corresponding waste heat load is 1.26×10^{10} Btu/hour for the existing units combined.

The evaporative losses from the new units were determined as follows;

Evaporation rates from Unit 3's wet cooling towers were calculated on a daily basis as a function of air temperature and relative humidity, utilizing performance data supplied by a cooling tower vendor, and a waste heat load of 1.03×10^{10} Btu/hour from the circulating and plant service water systems. Evaporation rates were determined for plant operation in the Energy Conservation (EC) and Maximum Water Conservation (MWC) modes, as described in Section 3.4.1.1. In the EC mode, which applies when lake levels are at or above elevation 250 ft msl, Unit 3's circulating water system wet cooling towers would be used to dissipate 100% of the waste heat from the main condenser. When lake levels fall below elevation 250 ft msl for 7 successive days, the plant is assumed to be operated in the MWC mode, wherein the dry towers would be used to dissipate a minimum of about 1/3 of the waste heat and the wet towers would be used to dissipate the remaining waste heat. For any given time step, the determination of whether Unit 3 would be in an EC or MWC mode of operation was made based on the lake elevation from the previous time step. The circulating water system cooling tower evaporation rates were combined with those from the service water cooling towers, corrected to reflect a 96 percent plant capacity factor for Unit 3, and averaged to obtain weekly values for use in the water budget model. The closed-cycle dry cooling systems of Unit 4 would introduce no to negligible additional evaporative losses.

ER Section 5.2.2.1.3, Model Results. This section is revised to report the Lake Anna outflow frequency, low water level frequency, and minimum water level associated with the operation of Unit 3's closed-cycle, dry and wet cooling tower system. ER Section 5.2.2.1.3, including Tables 5.2-3 and 5.2-4 will be revised to read as follows:

The water balance model described above has been used to predict releases from the North Anna Dam and water levels in Lake Anna on a weekly basis for the 24-year period extending from October 1, 1979, through April 10, 2003 considering the addition of Unit 3 as described above. For comparative purposes, the existing units running at a plant capacity factor of 93 percent, which exceeds their historical operating experience, have been simulated as well. An assumption inherent to this analysis is that the climatic conditions and variations during this historical period would be representative of future conditions. Figure 5.2-2 and Table 5.2-3 summarize the results for water releases from the North Anna Dam. Figure 5.2-3 and Table 5.2-4 summarize the results for Lake Anna water levels. A discussion of these results is provided below.

Table 5.2-3 Lake Anna Low Outflow Frequency

Outflow (ft^3/s)	Percent of Time Outflow Is Less Than or Equal to Indicated Values	
	Exiting Units	Existing Units plus Unit 3
100	50.6%	56.1%
80	48.2%	53.4%
60	46.5%	51.1%
40	44.6%	49.6%
20	5.2%	7.3%

Figure 5.2-2 illustrates the variation in the flow released from the North Anna Dam as a function of time for the 24-year period as simulated by the water balance model for the existing units, and the existing units with the addition of Unit 3. These results indicate that outflows from the dam vary seasonally and annually. Typically, flow rates are relatively high in the wetter fall and winter months due to the need to release water in order to maintain the normal pool elevation of 250 ft msl. Releases

in the drier summer months are typically limited to the minimum releases required by the Lake Level Contingency Plan. With the onset of wetter conditions in the fall months, inflows to the lake increase, and releases typically increase above the minimum values. Exceptions to this pattern would have occurred during the droughts of 1980–1981 and 2001–2002 during which the minimum release was maintained over the winter months due to diminished lake inflow.

Table 5.2-3 summarizes the outflow frequency for the low flows of interest. Results for the existing units indicate that water would have been released from the dam at a rate of 40 cfs or less for 44.6 percent of the time and at a rate of 20 cfs for 5.2 percent of the time. These frequencies increase with the increasing plant water needs associated with the addition of Unit 3 to 49.6 percent and 7.3 percent of the time, respectively.

Figure 5.2-3 illustrates the variation in Lake Anna water level as a function of time, as simulated by the water balance model for the two cases under consideration. These results indicate that the water level in Lake Anna varies seasonally and annually in response to climatic conditions. The typical seasonal pattern is as follows. Water levels are normally at their minimum values in October, the beginning of the water year. In response to runoff from fall and winter precipitation, water levels then normally increase to the normal operating pool level of 250 ft msl. This normal pool level is usually maintained over the winter months. With the reduction in precipitation beginning in April, decreased tributary inflows, and increased lake evaporation, water levels in the lake are typically drawn down during the summer months such that the maximum annual drawdown occurs near the end of the water year in September. The magnitude of the lake drawdown varies year to year in response to annual variations in surface water and groundwater inflow, which are caused by annual variations in climate conditions. In particular, the maximum annual drawdown during drought years, such as 1980–1981 and 2001–2002, is substantially greater than in other years.

Table 5.2-4 provides the water level frequency for the low water levels of interest to Lake Anna users and the minimum water level for the 24-year simulation period. These results demonstrate that the percent of time that the water level is less than or equal to a given elevation increases with the increasing plant cooling water needs associated with the addition of Unit 3. The results also indicate that the minimum water level for the simulation period decreases with increasing plant cooling water needs of Unit 3. Note that the minimum water levels are above elevation 242 ft msl, which is the minimum operating elevation specified in Technical Requirements

Manual for Units 1 and 2 (Reference 7) and the proposed minimum operating elevation proposed for Units 3 and 4.

Table 5.2-4 Lake Anna Low Water Level Frequency

Elevation (ft msl)	Percent of Time Water Level is Less Than or Equal to Indicated Values	
	Existing Units	Existing Units plus Unit 3
248	5.2%	7.0%
246	1.1%	1.4%
244	0%	0%
242	0%	0%
Minimum Water Level	245.1 feet	244.2 feet

ER Section 5.2.2.2, Analysis and Evaluations of Impacts on Water Use. This section is revised to report the impacts of operating Unit 3's closed-cycle, dry and wet cooling tower system on lake levels and lake outflows. Paragraphs 2, 4, 5, 6, 9, and 10 of ER Section 5.2.2.2 will be revised to read as follows:

The results described in Section 5.2.2.1 indicate there would be water-use impacts associated with the operation of Unit 3. These impacts include reductions in the volume of water available for release from the North Anna Dam, which would decrease the volume of water available for downstream users. Impacts also include increases in lake drawdown during the summer months, which could impact other lake users. These impacts are analyzed and evaluated below. Section 5.2.2.1 indicates that the operation of Unit 4 would have no or negligible water-use impacts.

Results included in Figure 5.2-2 and Table 5.2-3 quantify the impact of the releases from the North Anna Dam that would occur with the addition of Unit 3. Given that the minimum releases would comply with the existing VPDES permit Lake Level Contingency Plan (Reference 2), there would be no impact on downstream water users in terms of the minimum flow rate in the North Anna River. The duration of the minimum flow release rates would increase with the addition of Unit 3, however. For the existing units, the duration for which the minimum release is less than or equal to 40 cfs would be 44.6 percent of the time; and the duration for which the minimum release is 20 cfs would be 5.2 percent of the time. Comparable durations with the addition of Unit 3 are 49.6 percent of the time for flows less than or equal to 40 cfs, and 7.3 percent of the time for a flow of 20 cfs. Potential impacts would be greatest in the reach of the North Anna River extending from below the North Anna Dam to its confluence with the South Anna River.

To better quantify impacts to instream flows in the North Anna River, Indicators of Hydrologic Alteration (IHA) have been calculated for the outflow from the North Anna Dam under both pre- and post-impact conditions, and the Range of Variability Approach (RVA) has been applied to assess hydrologic alteration. These analyses have been performed using the methodology proposed by Richter et al. (Reference 8, Reference 9, Reference 10), which calculates statistical descriptions of the streamflow record and changes in these statistics for 33 hydrologic parameters. These parameters are organized into five groups that are intended to characterize the following:

- Magnitude of monthly water conditions
- Magnitude and duration of annual extreme water conditions
- Timing of annual extreme water conditions

- *Frequency and duration of high and low pulses*
- Rate and frequency of water condition changes

The IHA software package (Reference 11) has been used to perform the IHA and RVA analyses. Note that the current release of the IHA software (Version 7) calculates some parameter values differently that those computed by earlier versions of the software. In particular, the monthly flow values determined for non-parametric analysis are now medians, whereas in previous versions of the software, these values were means. Any statistics subsequently derived from these sub-annual data also would be affected. The application of this methodology to the North Anna River and associated results are described below.

IHA were calculated for the Lake Anna weekly outflows as predicted by the water balance model described in Section 5.2.2.1. The period of record for this simulation includes water years 1979–2002 (24 years). Daily outflows, required as input to the IHA software package, were obtained through linear interpolation of the weekly time series. The pre-impact condition is defined to be Lake Anna in its current, impounded condition with the existing Units 1 and 2 utilizing the lake for condenser cooling. The post-impact condition assumes the addition of Unit 3 with a closed-cycle, dry and wet cooling tower system, and the addition of Unit 4 with a closed-cycle dry tower system. Note that the heat dissipation system selected for Unit 4 will have negligible impacts to lake levels or outflows.

Results of the statistical analyses are summarized in Table 5.2-5, Table 5.2-6, and Table 5.2-7. Table 5.2-5 includes the 10 percent, 25 percent, 50 percent, 75 percent, and 90 percent quantiles for each of the 33 hydrologic parameters for pre- and post-impact conditions. Table 5.2-6 summarizes the results of the IHA analysis, provides the medians and coefficients of dispersion for each hydrologic parameter in a "scorecard" format, and quantifies changes in the IHA between the pre-impact and post-impact water regimes. Table 5.2-7 provides the results of the RVA analysis. In each of these tables, the IHA statistics have been calculated non-parametrically as recommended in the IHA User's Manual (Reference 11). Note that post-impact period is assumed to extend from 2003–2026 for the purpose of comparing pre- and post-impact streamflow statistics. Also note that several IHA are associated with durations of less than 7 days (e.g., 1-day minimum flow). Because the daily outflows were obtained through linear interpolation of the weekly values, any of the IHA associated with durations of less than 7 days may not be representative.

The results in Table 5.2-5, Table 5.2-6, and Table 5.2-7 indicate that there are no changes in the median 7-day, 30-day, and 90-day minimum flows as a consequence of adding Unit 3. The results do indicate greater variability in the minimum flows with

the addition of Unit 3. Results included in Table 5.2-5, Table 5.2-6, and Table 5.2-7 also demonstrate that the Julian date of the annual maximum does not change significantly with the addition of Unit 3. This would indicate that the spring spawning regime in the North Anna River below the North Anna Dam would not be impacted by the operation of a new Unit 3 on Lake Anna.

Results presented in Figure 5.2-3 and Table 5.2-4 quantify the impact on lake levels that would occur with the addition of Unit 3. Figure 5.2-3 indicates that the maximum annual drawdown in most years would not differ greatly from the current operation of the existing units. This figure also shows that the minimum lake levels occur in the latter half of the calendar year. To further quantify the impact on lake levels associated with the addition of Unit 3, the minimum lake elevation for the latter half of each year in the 1978–2002 period simulated along with the date on which the minimum lake elevation would have occurred have been summarized in Table 5.2-8. Data are provided for both pre-impact (existing units by themselves) and post-impact (existing units plus Unit 3) conditions. The last column in Table 5.2-8 represents the difference between post- and pre-impact minimum lake elevations for each year.

The Table 5.2-8 results indicate that annual minimum lake elevations under post-impact conditions are 0.01 to 0.89 feet lower than for pre-impact conditions, with this difference averaging 0.26 feet. The greatest difference occurs during drought years, such as those that occurred in 1981 (0.79 feet) and 2002 (0.89 feet). During non-drought years, the differences in minimum lake elevations are significantly less. The Table 5.2-8 results further indicate that the minimum lake elevation occurs most frequently in October for the existing units by themselves and for the existing units plus Unit 3 (9 out of 25 years in both cases). With respect to the recreational impact due to the additional drawdown from operation of Unit 3, the analysis of the effects in non-drought years shows that the overall impacts on the lake levels are relatively small, with the minimum lake levels averaging 248.6 ft msl (versus 248.9 ft currently), mainly in the fall months. Throughout the summer months, the lake levels would be higher than these minimum levels. Although the recreational use of the lake would still be high in the early fall, the greatest use would be during the summer months. Therefore, the impacts on the recreational use of the lake due to decreases in lake level during these non-drought years would be small.

Lake drawdown to Elevation 244.2 ft msl would not impact the existing units. The Technical Requirements Manual for the existing units requires plant shutdown when the lake level drops below Elevation 242 ft msl (Reference 7). Results included in Table 5.2-4 indicate that lake levels would not fall to Elevation 242 ft msl when Unit 3 is added.

No other water-use impacts on surface water or groundwater users due to the normal operation of a new unit or units at the ESP site are anticipated other than those described above.

ER Section 5.2.2.3, Analysis of Water-Quality Changes. This section is revised to describe the discharge of blowdown and associated constituents from Unit 3's wet cooling towers to the WHTF. The 1st paragraph of ER Section 5.2.2.3 will be revised to read as follows:

The primary impact of operating new units at the ESP site on water quality would be the discharge of cooling tower blowdown from Unit 3's wet cooling towers to the WHTF for return to the North Anna Reservoir. The cooling tower blowdown would contain elevated levels of dissolved solids, concentrated by evaporation, and various anti-fouling chemicals as described in Section 3.4. The blowdown would also add a small amount of waste heat to the WHTF. Section 5.3.2 details and quantifies the thermal and chemical impacts.

ER Section 5.2.2.4, Proposed Practices to Minimize or Avoid Impacts. This section is revised to describe how the operating modes of the Unit 3 would be used to reduce adverse impacts on lake levels and reservoir releases during sustained dry periods. ER Section 5.2.2.4 will be revised to read as follows:

As described in Section 3.4.4.1, the closed-cycle dry and wet tower cooling system for normal plant cooling of Unit 3 would be operated to conserve water when lake inflows are insufficient to maintain a pool level of 250 ft or above. When lake levels fall below 250 ft msl and the level is not restored within a reasonable period of time (e.g., 7 days), the cooling system could be operated in a Maximum Water Conservation (MWC) mode. In this mode, only the dry tower would be used to dissipate the entire heat load from the surface condenser when the ambient dry bulb temperature is sufficiently low. When the ambient dry bulb temperature is above the temperature where the dry tower can reject the plant waste heat on its own, the necessary capacity of wet tower cells required to assist in the dissipation of condenser heat load would be placed in operation in series with the dry tower. The use of the MWC mode would reduce adverse impacts on lake levels and reservoir releases during sustained dry periods.

ER Section 5.2 References. References are revised to support text revisions.

ER Section 5.2 References will be revised to read as follows:

Section 5.2 References

1. *Updated Final Safety Analysis Report,* North Anna Power Station, Revision 38

2. Commonwealth of Virginia, Department of Environmental Quality, Authorization to Discharge Under the Virginia Pollutant Discharge Elimination System and the Virginia State Water Control Law, Virginia Electric & Power Company, North Anna Nuclear Power Station, Permit No. VA0052451, January 2001.

3. Linsley, Jr., R. K., M. A. Kohler, and J. L. H. Paulhus. *Hydrology for Engineers,* 2nd Edition, McGraw-Hill, 1975.

4. Ho, E., S. A. Wells, and E. E. Adams, User's Manual for Lake Anna Cooling Pond Model, Ralph M. Parsons Laboratory, Massachusetts Institute of Technology, January 1983.

5. Ho., E., and E. E. Adams, Final Calibration of the Cooling Lake Model, North Anna Power Station, Report No. 295, Ralph M. Parsons Laboratory, Massachusetts Institute of Technology, August 1984.

6. Ryan, P. J., and D. R. F. Harleman, An Analytical and Experimental Study of Transient Cooling Pond Behavior, Report No. 161, Ralph M. Parsons Laboratory, Massachusetts Institute of Technology, 1973.

7. Technical Requirements Manual for North Anna Units 1 & 2, Revision 41, Dominion, March 24, 2004.

8. Richter, B. D., J. V. Baumgartner, J. Powell, and D. P. Braun. A method for assessing hydrologic alteration within ecosystems. *Conservation Biology* 10:1163-1174, 1996.

9. Richter, B. D, J. V. Baumgartner, R. Wigington, and D. P. Braun. How much water does a river need? *Freshwater Biology* 37:231-249, 1997

10. Richter, B. D., J. V. Baumgartner, D. P. Braun, and J. Powell, A Spatial Assessment of Hydrologic Alteration Within a River Network. *Regul. Rivers: Res. Mgmt.* 14:329-340, 1998.

11. Indicators of Hydrologic Alteration, Version 7, User's Manual, The Nature Conservancy with Smythe Scientific Software and Totten Software Design, October 2005.

ER Table 5.2-5, IHA Percentile Data North River. This table is revised to report the impacts of operating Unit 3's closed-cycle, dry and wet cooling tower system on lake outflows. ER Table 5.2-5 will be revised to read as follows:

[See following pages]

Table 5.2-5 IHA Percentile Data North Anna River

	Pre-Impact Period: 1979-2002 (24 years)						Post-Impact Period: 2003-2026 (24 years)					
	10%	25%	50%	75%	90%	(75-25)/50	10%	25%	50%	75%	90%	(75-25)/50
Parameter Group #1												
October	40	40	40	79	259	0.97	21	40	40	58	221	0.44
November	30	40	104	273	365	2.25	20	40	48	217	312	3.71
December	30	40	196	332	525	1.50	30	40	161	269	501	1.43
January	40	98	380	529	780	1.14	40	43	359	506	759	1.29
February	40	165	344	592	1147	1.24	40	140	321	570	1122	1.34
March	107	199	480	713	1256	1.07	93	173	455	687	1231	1.13
April	46	146	300	448	1111	1.01	40	119	274	422	1083	1.11
May	40	76	152	318	501	1.59	40	53	123	288	472	1.92
June	40	40	49	111	274	1.47	40	40	46	80	243	0.86
July	40	40	40	63	331	0.58	40	40	40	40	300	0.00
August	40	40	40	90	208	1.24	36	40	40	43	177	0.07
September	40	40	40	40	227	0.00	30	40	40	40	199	0.00
Parameter Group #2												
1-day minimum	30	40	40	40	40	0.00	20	25	40	40	40	0.38

	Pre-Impact Period: 1979-2002 (24 years)						Post-Impact Period: 2003-2026 (24 years)					
	10%	25%	50%	75%	90%	(75-25)/50	10%	25%	50%	75%	90%	(75-25)/50
3-day minimum	30	40	40	40	40	0.00	20	25	40	40	40	0.38
7-day minimum	30	40	40	40	40	0.00	20	25	40	40	40	0.38
30-day minimum	26	40	40	40	40	0.00	20	27	40	40	40	0.33
90-day minimum	27	40	40	49	94	0.23	20	27	40	42	77	0.36
1-day maximum	269	1086	1642	2846	3961	1.07	257	926	1615	2817	3936	1.17
3-day maximum	262	1042	1614	2534	3681	0.92	249	890	1588	2505	3656	1.02
7-day maximum	250	976	1572	2067	3240	0.69	236	853	1545	2038	3215	0.77
30-day maximum	202	601	873	1317	1650	0.82	187	570	847	1290	1626	0.85
90-day maximum	121	411	598	796	1168	0.64	104	381	572	769	1143	0.68
Number of zero days	0	0	0	0	0	0	0	0	0	0	0	0
Base flow	0.08	0.10	0.15	0.25	0.65	0.98	0.08	0.10	0.15	0.23	0.46	0.83
Parameter Group #3												
Date of minimum	165	275	275	275	288	0.00	205	275	275	275	284	0.00
Date of maximum	339	38	85	170	275	0.36	339	33	82	143	275	0.30

	Pre-Impact Period: 1979-2002 (24 years)						Post-Impact Period: 2003-2026 (24 years)					
	10%	25%	50%	75%	90%	(75-25)/50	10%	25%	50%	75%	90%	(75-25)/50
Parameter Group #4												
Low pulse count	0	0	0	0	1	0.00	0	0	0	0	1	0.00
Low pulse duration	55	55	204	352	352	1.46	27	34	76	304	373	3.55
High pulse count	0.5	3	4	6	8	0.75	1	3	4	6	8	0.69
High pulse duration	9	12	18	22	29	0.52	9	11	15	20	28	0.55
Parameter Group #5												
Rise rate	10.21	15.45	21.91	31.13	38.49	0.72	12.67	16.44	22.54	30.52	36.43	0.62
Fall rate	-35.83	-30.68	-14.76	-10.09	-6.36	-1.39	-35.82	-31.39	-16.18	-10.01	-4.48	-1.32
Number of reversals	3	14	19	21	25	0.41	3	13	16	21	24	0.48

ER Table 5.2-6, Non-Parametric IHA Scorecard, North Anna River. This table is revised to report the impacts of operating Unit 3's closed-cycle, dry and wet cooling tower system on lake outflows. ER Table 5.2-6 will be revised to read as follows:

Table 5.2-6 Non-Parametric IHA Scorecard, North Anna River

	Pre-impact period: 1979-2002 (24 years)	Post-impact period: 2003-2026 (24 years)
Watershed area	343	343
Mean annual flow	283	257
Mean flow/area	0.82	0.75
Annual C. V.	0.84	0.95
Flow predictability	0.45	0.45
Constancy/predictability	0.71	0.70
% of floods in 60d period	0.26	0.26
Flood-free season	3	3

(continued on next page)

Table 5.2-6 Non-Parametric IHA Scorecard, North Anna River (continued)

	Medians		Coeff. of Disp.		Deviation Factor		Significance Count	
	Pre	Post	Pre	Post	Medians	C.V.	Medians	C.V.
Parameter Group #1								
October	40	40	0.97	0.44	0.00	0.54	0.00	0.74
November	104	48	2.25	3.71	0.54	0.65	0.73	0.48
December	196	161	1.50	1.43	0.18	0.05	0.66	0.88
January	380	359	1.14	1.29	0.06	0.14	0.76	0.69
February	344	321	1.24	1.34	0.07	0.08	0.91	0.83
March	480	455	1.07	1.13	0.05	0.06	0.83	0.88
April	300	274	1.01	1.11	0.09	0.10	0.78	0.84
May	152	123	1.59	1.92	0.19	0.21	0.49	0.52
June	49	46	1.47	0.86	0.04	0.42	0.99	0.33
July	40	40	0.58	0.00	0.00	1.00	0.00	0.20
August	40	40	1.24	0.07	0.00	0.94	0.00	0.55
September	40	40	0.00	0.00	0.00		0.00	0.00
Parameter Group #2								
1-day minimum	40	40	0.00	0.38	0.00		0.00	0.00
3-day minimum	40	40	0.00	0.38	0.00		0.00	0.00
7-day minimum	40	40	0.00	0.38	0.00		0.00	0.00
30-day minimum	40	40	0.00	0.33	0.00		0.00	0.00
90-day minimum	40	40	0.23	0.36	0.00	0.57	0.01	0.59
1-day maximum	1642	1615	1.07	1.17	0.02	0.09	0.96	0.79
3-day maximum	1614	1588	0.92	1.02	0.02	0.10	0.94	0.77
7-day maximum	1572	1545	0.69	0.77	0.02	0.11	0.85	0.81
30-day maximum	873	847	0.82	0.85	0.03	0.04	0.78	0.90

	Medians		Coeff. of Disp.		Deviation Factor		Significance Count	
	Pre	Post	Pre	Post	Medians	C.V.	Medians	C.V.
90-day maximum	598	572	0.64	0.68	0.04	0.05	0.60	0.92
Number of zero days	0	0	0.00	0.00			0.00	0.00
Base flow	0.15	0.15	0.98	0.83	0.02	0.15	0.96	0.76
Parameter Group #3								
Date of minimum	275	275	0.00	0.00	0.00		0.00	0.00
Date of maximum	85	82	0.36	0.30	0.02	0.16	0.72	0.82
Parameter Group #4								
Low pulse count	0	0	0.00	0.00			0.00	0.00
Low pulse duration	204	76	1.46	3.55	0.63	1.43	0.75	0.09
High pulse count	4	4	0.75	0.69	0.00	0.08	0.47	0.79
High pulse duration	18	15	0.52	0.55	0.16	0.06	0.38	0.87
The low pulse threshold is 40								
The high pulse level is 348								
Parameter Group #5								
Rise rate	21.91	22.54	0.72	0.62	0.03	0.13	0.84	0.61
Fall rate	-14.76	-16.18	-1.39	-1.32	0.10	0.05	0.83	0.89
Number of reversals	19	16	0.41	0.48	0.16	0.19	0.37	0.53

ER Table 5.2-7, IHA Non-Parametric RVA Scorecard, North Anna River. This table is revised to report the impacts of operating Unit 3's closed-cycle, dry and wet cooling tower system on lake outflows. ER Table 5.2-7 will be revised to read as follows:

[See following pages]

Table 5.2-7 IHA Non-Parametric RVA Scorecard, North Anna River

	Pre-impact period: 1979-2002				Post-impact period: 2003-2026				RVA Boundaries		Hydrologic Alteration (Middle Category)
	Medians	Coeff. Dispersion	Range Limits Min	Range Limits Max	Medians	Coeff. Dispersion	Range Limits Min	Range Limits Max	Low	High	
Parameter Group #1											
October	40	0.97	34	290	40	0.44	20	255	40	40	-0.13
November	104	2.25	20	702	48	3.71	20	675	40	233	0.14
December	196	1.50	20	658	161	1.43	20	634	45	259	0.13
January	380	1.14	20	836	359	1.29	20	812	151	465	0.00
February	344	1.24	20	2688	321	1.34	20	2664	241	485	0.13
March	480	1.07	20	1353	455	1.13	20	1328	271	644	0.25
April	300	1.01	20	1388	274	1.11	20	1360	172	388	0.25
May	152	1.59	20	648	123	1.92	20	618	92	255	0.00
June	49	1.47	20	561	46	0.86	20	531	40	104	0.27
July	40	0.58	20	486	40	0.00	20	455	40	43	0.20
August	40	1.24	20	331	40	0.07	20	318	40	40	-0.06
September	40	0.00	20	483	40	0.00	20	454	40	40	-0.06
Parameter Group #2											

	Pre-impact period: 1979-2002				Post-impact period: 2003-2026				RVA Boundaries		Hydrologic Alteration (Middle Category)
	Medians	Coeff. Dispersion	Range Limits Min	Range Limits Max	Medians	Coeff. Dispersion	Range Limits Min	Range Limits Max	Low	High	
1-day minimum	40	0.00	20	40	40	0.38	20	40	40	40	-0.18
3-day minimum	40	0.00	20	40	40	0.38	20	40	40	40	-0.18
7-day minimum	40	0.00	20	40	40	0.38	20	40	40	40	-0.18
30-day minimum	40	0.00	20	173	40	0.33	20	145	40	40	-0.25
90-day minimum	40	0.23	20	270	40	0.36	20	240	40	42	-0.08
1-day maximum	1642	1.07	40	4756	1615	1.17	20	4733	1283	2376	-0.13
3-day maximum	1614	0.92	40	4692	1588	1.02	20	4669	1233	2219	0.00
7-day maximum	1572	0.69	40	4577	1545	0.77	20	4554	1136	1930	0.13
30-day maximum	873	0.82	40	3432	847	0.85	20	3408	657	1185	0.00
90-day maximum	598	0.64	40	1931	572	0.68	20	1906	449	679	0.00
Number of zero days	0	0	0	0	0	0	0	0	0	0	0.00
Base flow	0.15	0.98	0.07	1.00	0.15	0.83	0.04	1.00	0.12	0.20	0.25

	Pre-impact period: 1979-2002				Post-impact period: 2003-2026				RVA Boundaries		Hydrologic Alteration (Middle Category)
	Medians	Coeff. Disper-sion	Range Limits Min	Range Limits Max	Medians	Coeff. Disper-sion	Range Limits Min	Range Limits Max	Low	High	
Parameter Group #3											
Date of minimum	275	0	153	313	275	0	153	292	275	275	0.00
Date of maximum	85	0.36	13	343	82	0.30	13	343	81	218	0.00
Parameter Group #4											
Low Pulse Count	0	0.00	0	1	0	0.00	0	2	0	0	-0.09
Low Pulse Duration	204	1.46	55	352	76	3.55	27	373	55	352	0.00
High Pulse Count	4	0.75	0	10	4	0.69	0	9	3	6	0.18
High Pulse Duration	18	0.52	5	36	15	0.55	4	36	13	18	0.00
The low pulse threshold is 40											
The high pulse level is 348											
Parameter Group #5											
Rise rate	21.91	0.72	4.38	47.15	22.54	0.62	2.86	57.71	16.08	28.33	0.22
Fall rate	-14.76	-1.39	-36.47	-2.86	-16.18	-1.32	-37.78	-2.86	-24.11	-10.90	0.11

	Pre-impact period: 1979-2002				Post-impact period: 2003-2026				RVA Boundaries		Hydrologic Alteration (Middle Category)
	Medians	Coeff. Dispersion	Range Limits Min	Range Limits Max	Medians	Coeff. Dispersion	Range Limits Min	Range Limits Max	Low	High	
Number of reversals	19	0.41	0	25	16	0.48	0	24	15	21	-0.08

Table 5.2-7 IHA Non-Parametric RVA Scorecard, North Anna River

	Assessment of Hydrologic Alteration								
	Middle RVA Category			High RVA Category			Low RVA Category		
	Expected	Observed	Alter.	Expected	Observed	Alter.	Expected	Observed	Alter.
	Parameter Group #1								
October	16	14	-0.13	7	6	-0.14	1	4	3.00
November	14	16	0.14	8	5	-0.38	2	3	0.50
December	8	9	0.13	8	6	-0.25	8	9	0.13
January	8	8	0.00	8	7	-0.13	8	9	0.13
February	8	9	0.13	8	7	-0.13	8	8	0.00
March	8	10	0.25	8	6	-0.25	8	8	0.00
April	8	10	0.25	8	6	-0.25	8	8	0.00
May	8	8	0.00	8	7	-0.13	8	9	0.13
June	15	19	0.27	8	4	-0.50	1	1	0.00
July	15	18	0.20	8	5	-0.38	1	1	0.00
August	16	15	-0.06	7	7	0.00	1	2	1.00
September	18	17	-0.06	5	5	0.00	1	2	1.00

Assessment of Hydrologic Alteration

	Middle RVA Category			High RVA Category			Low RVA Category		
	Expected	Observed	Alter.	Expected	Observed	Alter.	Expected	Observed	Alter.
Parameter Group #2									
1-day minimum	22	18	-0.18	0	0	0.00	2	6	2.00
3-day minimum	22	18	-0.18	0	0	0.00	2	6	2.00
7-day minimum	22	18	-0.18	0	0	0.00	2	6	2.00
30-day minimum	20	15	-0.25	1	1	0.00	3	8	1.67
90-day minimum	12	11	-0.08	8	6	-0.25	4	7	0.75
1-day maximum	8	7	-0.13	8	8	0.00	8	9	0.13
3-day maximum	8	8	0.00	8	7	-0.13	8	9	0.13
7-day maximum	8	9	0.13	8	7	-0.13	8	8	0.00
30-day maximum	8	8	0.00	8	7	-0.13	8	9	0.13
90-day maximum	8	8	0.00	8	7	-0.13	8	9	0.13
Number of zero days	24	24	0.00	0	0	0.00	0	0	0.00
Base flow	8	10	0.25	8	7	-0.13	8	7	-0.13

Assessment of Hydrologic Alteration

	Middle RVA Category			High RVA Category			Low RVA Category		
	Expected	Observed	Alter.	Expected	Observed	Alter.	Expected	Observed	Alter.
Parameter Group #3									
Date of minimum	17	17	0.00	4	3	-0.25	3	4	0.33
Date of maximum	8	8	0.00	8	7	-0.13	8	9	0.13
Parameter Group #4									
Low Pulse Count	22	20	-0.09	2	4	1.00	0	0	0.00
Low Pulse Duration	2	2	0.00	22	1	-0.95	0	1	0.00
High Pulse Count	11	13	0.18	8	6	-0.25	5	5	0.00
High Pulse Duration	9	9	0.00	9	6	-0.33	6	7	0.17
Parameter Group #5									
Rise rate	9	11	0.22	8	7	-0.13	7	4	-0.43
Fall rate	9	10	0.11	8	6	-0.25	7	7	0.00
Number of reversals	13	12	-0.08	5	4	-0.20	6	8	0.33

ER Table 5.2-8, Minimum Lake Elevation for the Latter Half of Years 1978–2002. This table is revised to report the impacts of operating Unit 3's closed-cycle, dry and wet cooling tower system on lake levels. ER Table 5.2-8 will be revised to read as follows:

Table 5.2-8 Minimum Lake Elevation for the Latter Half of Years 1978–2002

	Existing Units		Existing Units + Unit 3		Difference
Year[a]	Minimum Lake Elevation (ft MSL)	Date of Minimum Lake Elevation	Minimum Lake Elevation (ft MSL)	Date of Minimum Lake Elevation	in Minimum Lake Elevation (ft)
1978	248.44	11/5/1978	248.43	11/5/1978	-0.01
1979	250.07	7/29/1979	249.95	7/29/1979	-0.12
1980	248.48	10/26/1980	248.07	10/26/1980	-0.41
1981	248.04	10/11/1981	247.25	10/11/1981	-0.79
1982	249.48	10/10/1982	249.36	10/10/1982	-0.12
1983	248.56	10/2/1983	248.27	10/2/1983	-0.29
1984	249.87	9/16/1984	249.78	9/16/1984	-0.09
1985	249.64	8/4/1985	249.44	8/4/1985	-0.19
1986	248.69	10/12/1986	248.27	10/12/1986	-0.42
1987	248.99	8/23/1987	248.68	8/23/1987	-0.30
1988	248.87	10/23/1988	248.65	10/23/1988	-0.22
1989	249.94	8/27/1989	249.87	8/27/1989	-0.07
1990	249.67	9/30/1990	249.49	9/30/1990	-0.18
1991	248.83	11/10/1991	248.66	11/10/1991	-0.17
1992	249.63	9/13/1992	249.49	10/18/1992	-0.14
1993	248.33	11/14/1993	248.01	11/14/1993	-0.32
1994	249.91	10/2/1994	249.84	7/3/1994	-0.07

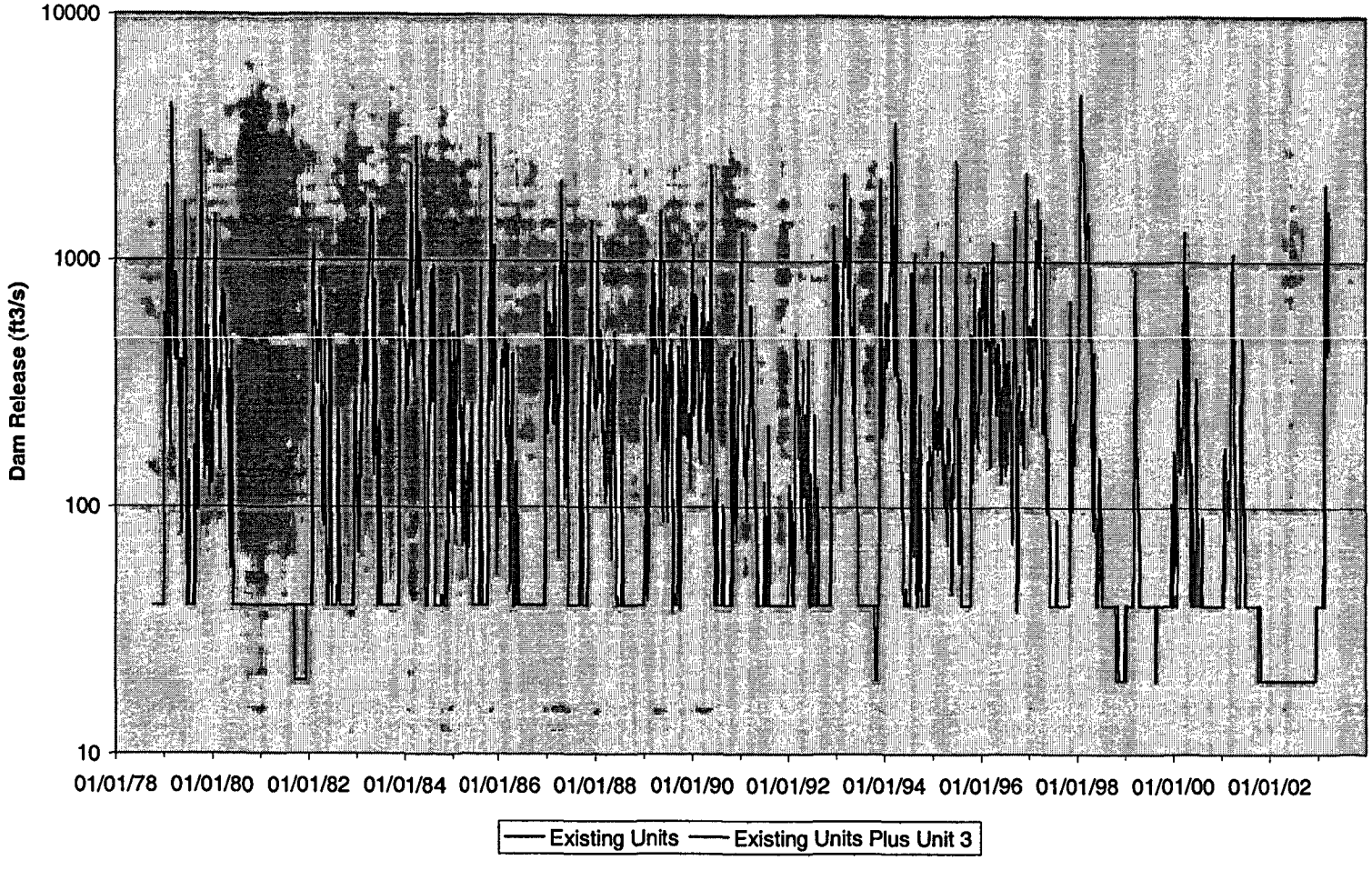
a. Minimum lake elevations identified from July-December period of each year to ensure independence of events.

Year[a]	Existing Units		Existing Units + Unit 3		Difference in Minimum Lake Elevation (ft)
	Minimum Lake Elevation (ft MSL)	Date of Minimum Lake Elevation	Minimum Lake Elevation (ft MSL)	Date of Minimum Lake Elevation	
1995	249.27	9/17/1995	249.08	9/17/1995	-0.19
1996	250.04	9/22/1996	250.01	9/22/1996	-0.03
1997	249.31	10/5/1997	248.95	10/5/1997	-0.36
1998	247.81	11/22/1998	247.56	11/22/1998	-0.25
1999	248.34	8/15/1999	248.01	8/15/1999	-0.33
2000	249.48	11/12/2000	249.25	11/12/2000	-0.23
2001	247.33	12/30/2001	247.04	12/30/2001	-0.28
2002	245.06	10/13/2002	244.17	10/13/2002	-0.89

ER Figure 5.2-2, Lake Anna Outflow Hydrographs. This figure is revised to illustrate the impacts of operating Unit 3's closed-cycle, dry and wet cooling tower system on lake outflows. ER Figure 5.2-2 will be revised as follows:

[See next page]

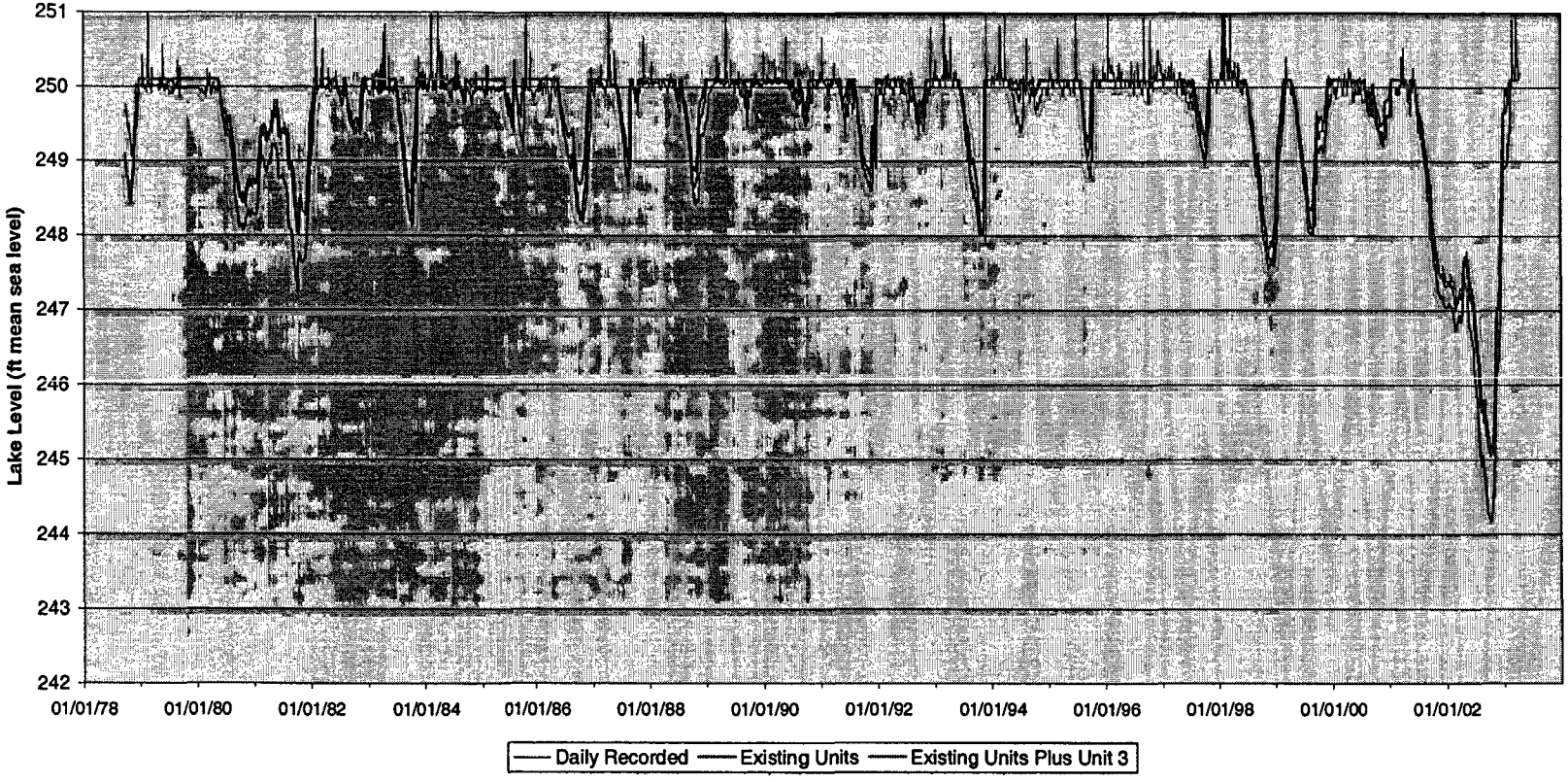
Figure 5.2-2
Lake Anna Outflow Hydrographs



ER Figure 5.2-3, Lake Anna Water Level Hydrographs. This figure is revised to illustrate the impacts of operating Unit 3's closed-cycle, dry and wet cooling tower system on lake levels. ER Figure 5.2-3 will be revised as follows:

[See next page]

Figure 5.2-3
Lake Anna Water Level Hydrographs



ER Section 5.3, Cooling System Impacts. This section is revised to reflect the use of closed-cycle dry and wet cooling towers for Unit 3 and to describe that Lake Anna would be the source of make-up water needs for Unit 3. The 1st and 2nd paragraphs of ER Section 5.3 will be revised to read as follows:

This section discusses the impacts on Lake Anna of the cooling systems associated with operation of new units at the ESP site. As described in Section 3.3, and Section 3.4, the lake would be the main source of cooling water make-up for the new units.

For normal plant operation, Unit 3 would use a closed-cycle combination dry and wet cooling tower system for the circulating water system and closed-cycle wet towers for the service water system, both with cooling water make-up supply from the lake. Unit 4 would use closed-cycle dry cooling towers for the circulating water system and for the service water system cooling during normal plant operation. As presented in Section 3.4.1.1, there would be negligible impacts to Lake Anna from the closed-cycle dry cooling tower systems that would be used for Unit 4. For those reactor designs that require an UHS, safety-related cooling would be provided by mechanical draft cooling towers. Those cooling towers would have a separate basin to provide a minimum 30-day water supply. The lake would provide make-up to this 30-day storage basin as necessary. Make-up water would be withdrawn from the North Anna Reservoir through a new intake structure located in a cove adjacent to the intake structure for the existing units. All cooling system discharges for the new units, including the UHS tower blowdown, would be sent to the WHTF via a new outfall at the head of the existing discharge canal.

ER Section 5.3.1, Intake System. This section is revised to reflect the maximum make-up water flow rate to be supplied by the new intake for Unit 3. The screen wash flow, typically not considered in the hydraulic sizing of a once-through cooling system intake due to its relatively small contribution, is now included in the make-up water intake analysis. The 2nd, 3rd, and 4th paragraphs of ER Section 5.3.1 will be revised to read as follows:

As described in Section 3.4.2, the new units intake system would consist of an intake structure at the end of an approach channel located in a cove on the south shore of the North Anna Reservoir near Harris Creek. The area that would be occupied by this intake system, originally planned for the intake of the abandoned Units 3 and 4, is adjacent to the cove that houses the intake structure for the existing units.

During normal plant operation, the new intake would supply make-up water at a maximum flow rate of 2.23×10^4 gpm (49.6 cfs) to the closed-cycle wet cooling towers of Unit 3, and up to 1 gpm (0.002 cfs) of make-up water to the closed-cycle dry cooling towers of Unit 4. The new intake structure would also supply lake water as make-up water to the underground storage basins of the UHS cooling towers.

Other water use for the new units, including demineralized water and fire protection water, would be supplied through the new intake structure as well. According to Section 3.3.1, the total of the maximum incidental plant water usage would be an additional 4920 gpm (11 cfs) of intermittent intake flow per each new unit. The new intake structure would be equipped with screen wash pumps that would withdraw up to 1.1 cfs per unit of lake water to clean the traveling water screens. The screen wash flow would be returned back to the intake upstream of the traveling water screens after cleaning and would result in no water loss.

ER Section 5.3.1.1, Hydrodynamic Descriptions and Physical Impacts. This section is revised to reflect the maximum make-up water flow rate to be supplied by the new intake for Unit 3. The screen wash flow, typically not considered in the hydraulic sizing of a once-through cooling system intake due to its relatively small contribution, is now included in the make-up water intake analysis. The Unit 3 cooling system discharge is also revised to reflect blowdown flow from the wet cooling towers. The 3rd through 6th paragraphs of ER Section 5.3.1.1 will be revised to read as follows:

As described in Section 3.3 and Section 3.4, the North Anna Reservoir would also be a main source of cooling water make-up for Unit 3 during normal station operation. Unit 4 plant cooling would be provided by dry cooling towers, which require no or a negligible amount of make-up water.

The lake would also provide make-up water to maintain the separate 30-day supply of emergency cooling water needed for the UHS for both new units, as presented in Section 3.4.2. However, during any shutdown requiring the UHS, no cooling or make-up water from the lake would be needed for any of the affected reactors to reach safe shutdown.

The new intake system would consist of a compartmented intake structure with a common screen well, separate pump bays dedicated to each unit, and an approach channel in the cove adjacent to the intake for the existing units. During normal plant operation, the new intake system would supply up to 49.6 cfs of cooling water make-up to the closed-cycle wet cooling towers of Unit 3 and zero to 0.002 cfs of make-up water to the closed-cycle dry cooling towers of Unit 4. Additional plant water needs of up to 2.5 cfs (during normal conditions), 11 cfs (during upset or abnormal conditions) for each new unit, including water to supply the demineralized water system, fire protection water, and the make-up water for the 30-day storage of UHS cooling tower, would also be withdrawn from the lake through the new intake structure. An additional 1.1 cfs of screen wash water per new unit would be withdrawn from the intake but would be returned back to the intake flow upstream of the traveling water screens resulting in zero net water use. These incidental plant water needs would be intermittent and small compared to the once-through cooling water flow of the existing units. They would have no adverse physical impact to the lake.

At the downstream end of the plant cooling system, a new outfall would discharge up to 12.4 cfs of blowdown effluent from the wet towers of Unit 3. The closed-cycle dry cooling towers of Unit 4 would have no blowdown discharges. Other permitted plant discharges, including discharges from the demineralized water and sanitary waste systems, would be released to the new outfall, but their volume would be small and

would have no physical impact on the lake. The new outfall structure would be next to the outfall of the existing units at the head of the discharge canal in the WHTF. From the discharge canal, the cooling tower blowdown from Unit 3 and the cooling water discharge from the existing units would flow through the WHTF's various canals, ponds, and side-arms to dissipate heat, and would eventually re-enter the North Anna Reservoir at Dike 3 via six adjustable submerged skimmerwall gates. The physical impacts of the operation of the discharge system are presented in Section 5.3.2.1.

ER Section 5.3.1.1.1, Lake Hydrologic Characteristics. This section is revised to reflect the impact due to the use of closed-cycle dry and wet tower system for Unit 3, the minor changes of the long term average inflow to the lake, and the long term average outflow from the lake with existing units operating only. ER Section 5.3.1.1.1 will be revised to read as follows:

Section 2.3.1 describes the hydrologic characteristics of the Lake Anna watershed and the impoundment that was created by the construction of the North Anna Dam. Figure 5.3-1 is a map of Lake Anna showing the upper lake, mid-lake and lower lake reaches of the North Anna Reservoir, the WHTF, as well as the relative location of the existing station intake, the new intake, and the discharge canal.

Lake Anna is about 17 miles long with a shoreline length of approximately 272 miles. At the normal operating lake level of 250 ft msl, the reservoir and the WHTF have a combined volume of 305,000 acre-feet and a surface area of approximately 13,000 acres. The watershed area above the dam draining into Lake Anna is 343 square miles. Based on the water budget analysis described in Section 5.2.1, the long-term average inflow to the lake including surface water runoff, direct precipitation, and ground water flow is estimated to be about 369 cfs. The average outflow at the dam varies, depending on various water uses on the lake, including water loss due to evaporation. The outflow is estimated to be about 276 cfs during the operation of the existing units.

The hydrologic characteristics of the North Anna Reservoir gradually change from riverine upstream to lacustrine downstream. The upper lake is primarily riverine, shallow (average depth of 4 m (13 ft)) and slightly stratified in summer. The mid-lake is more lacustrine and stratified. The lower lake is deeper (average depth of 11 m (36 ft)) and displays lacustrine characteristics (e.g., more vertical gradients of light, temperature, and decomposition). Both the lower lake and mid-lake reaches tend to be stratified in summer and mixed in winter. (Reference 2)

Because the additional waste heat from the new units discharged through the WHTF to the North Anna Reservoir would be negligible, there would be no perceptible impact on the temperature or stratification in Lake Anna as discussed in Section 5.3.2.1.

According to the Lake Anna Special Area Plan (Reference 3), the primary cause of lakeshore erosion is wave action induced by wind and wakes from boats. The additional units would have no impact on lakeshore erosion due to the small intake and discharge flow rates associated with their proposed operation.

5.3.1.1.2, Intake Hydrodynamics and Physical Impacts. This section is revised to reflect the new reduced intake flow rate for Unit 3's closed-cycle dry and wet cooling tower system, and to describe the impact of the reduced average flow velocity in the reservoir and the approach channel. ER Section 5.3.1.1.2 will be revised to read as follows:

The hydrodynamics of the North Anna Reservoir are different from those of most other lakes and reservoirs, in that during station operation, the mid-lake and lower lake reaches, where the intakes and the Dike 3 skimmer gates are located, have a circulation pattern induced by the plant circulating water flow. Most of the cooling water from the existing plant, which discharges at a rate of up to 4246 cfs into the reservoir via Dike 3, is drawn uplake by the cooling water and service water pumps in the existing intake structure. Since the circulating water flow is very large compared to the average inflows to the lake and the average release flow at the dam, the plant's cooling system flow dominates the circulation in the lake except during periods of high inflows from the tributaries upstream.

As shown in Figure 5.3-1, the width of the reservoir perpendicular to the main flow direction varies from less than 1600 feet near Dike 1 to over 7000 feet near Dike 2 in the lower lake reach. With a typical epilimnion thickness of 26 feet to 33 feet in the lower lake region during the operation of the existing units (Reference 2), the induced surface current is estimated to be flowing in a general uplake direction at 0.1 fps or less on the average during the normal lake level of 250 ft msl. The colder return flow from the upper lake toward the dam occurs in the lower part of the water column (the hypolimnion) and is predicted to have a lower velocity. A conservative estimate has been made based on the assumption that the return flow would be the same as the total inflows to the lake. In the lower lake reach upstream of the Dike 3 discharge, the velocity of the bottom current is predicted to be less than 0.1 fps on a long-term average basis. The flow near Dike 3 is more complicated and is dominated by the mixing process at the skimmer gates. The outfall hydrodynamics and the physical impacts to the lake are presented in Section 5.3.2.1. With operation of the new units, the additional blowdown discharge of 12.4 cfs from Unit 3 flowing through Dike 3 to the reservoir would not have any measurable impact on the lake hydrodynamics. The operation of the new intake system would not increase the lake current by any detectable extent and would have no adverse impact on the scouring of the lakebed or erosion of the shoreline.

Water quality parameters in the lake and the WHTF were measured as part of the 316(a) demonstration study for the existing units (Reference 2). Measured turbidity levels were reported as generally low, except during periods of heavy inflows from

the tributary streams. According to the 316(a) demonstration study, the mean annual turbidities from 1981 to 1986 ranged from 6 to 10 NTUs in the upper lake, and 2 to 5 NTUs in the lower lake reaches. Most of the turbidity measurements greater than 15 NTUs were taken in February, March, and April, months with higher runoff. The combined operations of the existing and new units would not increase turbidity in the lake.

The intake channel for the existing units has a bottom width of approximately 320 feet at the mouth of the cove opening to the North Anna Reservoir, and narrows down to 185 feet wide just in front of the screen well. The channel banks have a typical side slope of 3:1 (horizontal to vertical) and the bottom of the channel has been dredged to Elevation 220 ft msl. At a proposed minimum operating lake level of Elevation 242 ft msl and the existing intake flow rate of up to 4310 cfs, the flow velocity in the channel is estimated to be about 0.5 fps at the mouth to less than 1 fps at the approach to the screen well. At the normal lake level of 250 ft msl, the velocity in the existing channel is slightly lower, in the range of 0.3 fps to 0.8 fps. The approach channel of the new intake has a bottom width that varies from approximately 300 feet near the mouth to 230 feet upstream of the screen well and pump house. The channel bottom is at Elevation 220 ft msl approximately and the channel banks have a side slope of about 3:1 (horizontal to vertical). At the proposed minimum lake operating level of Elevation 242 ft msl, the flow velocity in the channel would be about 0.01 fps, based on the maximum combined intake flow rate of 72 cfs (which includes 49.6 cfs of cooling water make-up from Unit 3, 0.002 cfs of cooling water make-up potentially required for Unit 4 and 11 cfs of miscellaneous plant water uses per new unit during upset or abnormal conditions) for the new units. At the normal operating lake level of 250 ft msl, the velocity in the approach channel to the new intake would be further reduced. Because there is no indication of scour or erosion at the existing intake, and because the new units would have lower approach velocities than the existing units; neither intake channel is expected to have any scouring and erosion concerns on the bottom or shoreline. In the event that a partial opening, instead of a full opening, would be constructed at the cofferdam to connect the reservoir and the approach channel to the new intake, the through flow velocity at the opening would be designed to be no greater than 0.1 fps, similar to the average current velocity in the reservoir, to reduce impact to the lake hydrodynamics and entrainment of debris, aquatic life and sediment.

Lake Anna in general does not have a sediment problem. Siltation in the approach channel to the new intake would not be a concern during normal lake conditions as the coarse and medium sediment would settle out in the reservoir where the current

velocity is typically small on the order of 0.1 fps or less. Sediment could come into the approach channel during floods and deposit there due to the low channel velocity. Operation of the new intake, however, would not be affected because the channel bottom is 12 feet deeper than the design invert of the new intake, allowing room for occasional sediment deposition and buildup. Any suspended sediment entrained into the intake structure would remain in suspension as the flow velocity increased downstream of the screen well and pump house, and would either be filtered out during the water treatment process or carried through the plant cooling system and discharged to the WHTF.

The banks of the approach channels to the new intake and the existing intake are stabilized with riprap to protect against erosion due to wind waves. Any areas that would be disturbed during the construction of the new intake would be stabilized in a similar fashion. The design approach velocity to the traveling water screens and trash racks would be less than 1.0 fps at the lowest estimated operating lake level of 242 ft msl, and would enhance the performance of the debris filtering system, and create a non-eroding environment. The new intake structure would have a sill at the entrance to avoid the entrainment of bed sediment into the screen well and pump house. Regular maintenance dredging during operation of the new units would not be necessary.

Section 5.3.1.2 discusses in further detail the impact of the operation of the intake system on the aquatic ecosystem of the lake.

ER Section 5.3.1.2.1, Impingement. This section is revised to reflect significantly less impingement due to greatly reduced intake flow rate. Subparagraphs a. and b. as well as Tables 5.3-2 and 5.3-3 of ER Section 5.3.1.2.1 will be revised to read as follows (Table 5.3-4 is deleted):

a. **Impingement Estimate for Unit 3 Using Dry and Wet Cooling Towers**

In order to estimate the impacts of the addition of a new CWIS with a maximum intake flow of 27,309 gpm on the impingement of fish in the North Anna Reservoir, data from the 1978–1983 sampling study (Reference 4) were used. The following assumptions were used to extrapolate fish impingement rates for a new cooling tower make-up system:

- Fish distribution and composition has remained generally the same as in the 1978–1983 study,
- A new CWIS would operate at 100 percent pumping capacity, and
- The intake screen mesh size and approach flow velocity of the new units would be the same as that of the existing units.

These assumptions were used to provide a very conservative estimate which results in bounding impingement estimates that are considerably higher than expected.

Based on the impingement rate for the six representative important fish species from the 1978–1983 study and assuming the maximum flow rate of 27,309 gpm and 100 percent pumping capacity, an estimate of the total number of fish that could be impinged was calculated. Mean monthly impingement estimates for the six representative important fish species were calculated for the same five full years of operation (Table 5.3-2). It was determined that using the mean of the five representative years would give the most accurate estimate for annual fish impingement. As expected, gizzard shad dominated the impingement estimates for the new system with an estimated annual impingement of approximately 3,460 fish. This estimate is about 97 percent less than the yearly estimate for the existing units (Table 5.3-1), and is primarily due to significantly less cooling water intake flow for the new unit.

Table 5.3-2 Mean Number of Representative Important Fish Species Estimated Impinged per Month at NAPS With a Cooling Tower Water Make-up Intake System for Unit 3

Month	Striped Bass	Black Crappie	Bluegill	Gizzard Shad	White Perch	Yellow Perch	Total All Species
January	6	21	3	277	2	1	310
February	8	57	6	696	4	40	811
March	11	304	14	2,123	18	788	3,258
April	3	150	17	233	15	62	480
May	0	39	15	46	14	3	117
June	0	12	18	2	3	2	37
July	0	7	7	2	3	1	20
August	0	7	19	1	3	0	30
September	0	15	11	7	3	1	37
October	1	79	13	4	4	0	101
November	8	58	39	14	3	1	123
December	15	34	6	55	5	1	116
Yearly Totals	52	783	168	3,460	77	900	5,440

Estimated impingement for the other representative important species would be proportional to those of the existing units. In addition, seasonal impingement would be highest during the winter and lowest during the summer; all reflective of the 1985 study (Table 5.3-2).

Cumulatively, based on the maximum flow rate and 100 percent pumping capacity, impingement would increase by less than 3 percent with the addition of Unit 3. Total estimated impingement for the six representative important species would be approximately 188,000 fish annually. Approximately 94

percent of the annual impingement would be gizzard shad (63 percent), yellow perch (16 percent), and black crappie (15 percent) (Table 5.3-3).

Table 5.3-3 Mean Number of Representative Important Fish Species Estimated Impinged per Month with Existing Units and With a Unit 3 Cooling Tower Make-up Water Intake System

Month	Striped Bass	Black Crappie	Bluegill	Gizzard Shad	White Perch	Yellow Perch	Total All Species
January	219	950	137	14,877	94	45	16,322
February	273	2,417	241	27,155	166	1,432	31,684
March	392	10,038	479	60,437	643	25,224	97,213
April	90	4,497	653	8,640	486	1,816	16,192
May	10	1,682	645	1,653	404	87	4,481
June	-	492	857	59	138	51	1,597
July	-	379	399	69	167	40	1,054
August	3	433	1,004	85	162	23	1,710
September	12	860	655	492	164	20	2,203
October	31	3,528	587	240	164	5	4,555
November	365	2,201	1,983	728	179	27	5,483
December	697	1,245	299	2,882	236	37	5,396
Yearly Totals	2,092	28,722	7,939	117,857	3,003	28,807	187,880

b. **Impingement Estimates for Unit 3 Plus Unit 4**

Because Unit 4 would use a dry cooling tower system, there would be no regular withdrawal of water from Lake Anna and therefore no additional impingement impacts beyond those associated with Unit 3.

Table 5.3-4 Deleted

ER Section 5.3.1.2.2, Impingement Discussion. This section is revised to reflect significantly less impingement due to greatly reduced intake flowrate. The 2nd, 3rd, and 6th paragraphs of ER Section 5.3.1.2.2 will be revised to read as follows:

The percentage of the total reservoir population that is impinged is very low. Based on cove rotenone sampling in Lake Anna, the average annual standing crop of gizzard shad over a five year period (1979–1983) was 121 kg per hectare and the average annual impingement weight of gizzard shad was 2200 kg (Reference 4). Therefore, the average percentage of gizzard shad standing crop in the North Anna Reservoir that was removed annually by impingement was 0.32 percent by weight. Similarly, values for black crappie were 3.8 percent, yellow perch 1.4 percent, bluegill 0.02 percent, and white perch 0.1 percent (Reference 4). Using the assumptions presented earlier, the addition of Unit 3 would increase the number of fish impinged by less than 3 percent. Therefore, a new CWIS for Unit 3 in combination with the current once-through system for Units 1 and 2 would remove approximately 0.33 percent by weight of gizzard shad annually, 3.9 percent of black crappie, just over 1.4 percent of yellow perch, 0.02 percent of bluegill, and 0.1 percent of white perch. Adding Unit 4 with a new dry tower system would not increase these numbers because no regular water withdrawals would be made from Lake Anna for the new system.

Gizzard shad have a high reproductive potential because they grow rapidly, mature quickly, and produce a large number of eggs per female. As reported in Carlander (Reference 6), gizzard shad can reproduce at 2 years of age and each age-2 female can produce from 211,000 to 543,000 eggs. The average yearly combined impingement estimates for the existing units, and towers for Units 3 and 4, is approximately 115,000 gizzard shad, considerably less than the maximum egg production of one average size age-2 female gizzard shad. Likewise, black crappie become sexually mature at age-2 or age-3 and a mature female can produce from 11,000 to 188,000 eggs annually (Reference 7). The average yearly impingement estimates for black crappie from all existing and new units combined would be approximately 29,000 fish; well below the maximum egg production of one mature female. These trends hold true for the other representative important species.

The 1985 Section 316(b) study showed no significant impacts due to impingement, a conclusion validated by 20-plus years of monitoring in Lake Anna. In addition, the Section 316(a) demonstration (Reference 2) and more recent monitoring data and annual reports (Reference 10) indicate that Lake Anna fish populations are healthy and diverse. The operation of new cooling towers for Units 3 and 4 would not change

this conclusion. This conclusion is supported because the fish impinged most frequently are prolific, exhibit a high reproductive potential, and compensatory responses of the fish population would occur to offset losses due to impingement, and therefore would not require mitigation.

ER Section 5.3.1.2.3, Entrainment. This section is revised to reflect significantly less entrainment due to greatly reduced intake flow rate. Subparagraphs a. and b. as well as Tables 5.3-6 and 5.3-7 of ER Section 5.3.1.2.3 will be revised to read as follows (Table 5.3-8 is deleted):

a. **Entrainment Estimates for Unit 3 Using Dry and Wet Cooling Towers**

In order to estimate the impacts of the addition of a new CWIS with a maximum intake flow of 27,309 gpm on the entrainment of fish from the North Anna Reservoir, data from the 1978–1983 sampling study (Reference 4) were used. The following assumptions were used to extrapolate fish entrainment rates for a new cooling tower make-up system:

- Fish distribution and composition has remained generally the same as in the 1978–1983 study,
- A new CWIS would operate at 100 percent pumping capacity, and
- The intake screen mesh size and approach flow velocity of the new unit would remain the same as that of the existing units.

These assumptions were used to provide a very conservative estimate which results in bounding entrainment estimates that are considerably higher than expected.

Based on the entrainment rate (number per gallon) for the five representative important fish species from the 1978–1983 study and the maximum flow rates for the new CWIS, an estimate of the total number of these species' larvae entrained was calculated. As noted earlier in this section, the maximum cooling water withdrawal rate from the North Anna Reservoir for Unit 3 towers would be 27,309 gpm. Combined with current usage of 1,934,300 gpm for the existing Units 1 and 2, this would result in 3.6 percent of Lake Anna's volume being used each day. Entrainment rates were calculated for the following representative important species: gizzard shad, sunfishes, white perch, yellow perch, and black crappie.

Mean monthly and yearly entrainment estimates for Unit 3 were calculated for the five representative important fish species for each of the six years of the study (Table 5.3-6). Because the sampling period was similar in all six years, all data were used and an average yearly estimate was calculated. As expected, the entrainment estimates for Unit 3 follow those of the existing Units 1 and 2 very closely.

Entrainment estimates for Unit 3 averaged approximately 3,350,000 larvae annually, with gizzard shad dominating the estimates. Estimated entrainment for the other representative important species also would be proportional to those of the existing units on an annual and monthly basis.

Table 5.3-6 Mean Number of Representative Important Fish Species Estimated Entrained per Month With Cooling Tower Make-Up Water Intake System for Unit 3

Taxa	March	April	May	June	July	Yearly Totals
Black Crappie	-	-	29,547	11,595	-	41,143
Lepomis sp.	-	-	31,170	256,714	178,893	466,577
Gizzard Shad	-	8,809	1,153,671	904,014	49,889	2,114,381
White Perch	-	100,812	418,854	31,791	1,634	553,091
Yellow Perch	5,251	162,714	10,865	199	-	179,029
Monthly Totals	5,251	272,335	1,644,107	1,204,313	230,416	3,354,224

Cumulatively, entrainment would increase by less than 3 percent (Table 5.3-7) with the addition of a CWIS for Unit 3. As noted earlier, this is based on a maximum intake flow rate and 100 percent pumping capacity. Total estimated entrainment with the old and new units operating for the five representative important species would be approximately 152,000,000 fish larvae annually. Once again, gizzard shad would account for approximately 63 percent of all larvae entrained (Table 5.3-7).

Table 5.3-7 Mean Number of Representative Important Fish Species Estimated Entrained per Month With Existing Units And a Cooling Tower Make-Up Water Intake System for Unit 3

Taxa	March	April	May	June	July	Yearly Totals
Black Crappie	-	-	1,174,514	611,306	-	1,784,821
Lepomis sp.	-	-	923,425	887,392	17,079,735	22,716,967
Gizzard Shad	-	376,514	52,733,862	42,035,032	2,446,136	97,589,545
White Perch	-	4,024,668	17,567,757	1,850,587	94,454	23,546,466
Yellow Perch	228,764	6,472,027	395,665	10,599	-	7,107,055
Monthly Totals	228,764	10,873,209	72,804,223	57,089,382	11,751,474	152,744,854

b. **Entrainment Estimate for Unit 3 Plus Unit 4 Cooling**

Because Unit 4 would use a dry cooling tower system, there would be no regular withdrawals of water from Lake Anna and therefore no additional entrainment impacts beyond those associated with the CWIS for Unit 3.

Table 5.3-8 Deleted

ER Section 5.3.1.2.4, Entrainment Discussion. This section is revised to reflect significantly less entrainment due to greatly reduced intake flow rate. The 3rd and 4th paragraphs of ER Section 5.3.1.2.4 will be revised to read as follows:

The analysis from the adult equivalent model provided a conservative estimate of entrainment impact, primarily as a result of assumptions used in the analysis (Reference 4). Applying the adult equivalent model analysis to a CWIS for Unit 3 would increase the entrainment losses for the existing units by less than 3 percent (Reference 4). Losses of this magnitude would not impact the Lake Anna fishery. Adding Unit 4, with a dry cooling tower system, would not increase these entrainment numbers because no regular water withdrawals from Lake Anna would be required for this system.

The information summarized in Section 2.4.2 and in the *Environmental Study of Lake Anna and the Lower North Anna River Annual Report for 2000 including summary for 1998–2000* (Reference 10) indicates that the fish population in Lake Anna represents a balanced community. Over the years, the fishery of Lake Anna has matured and changed to meet the demands for public fishing through species additions (threadfin shad) and annual stockings of striped bass. Overall, the abundance and quality of the fishery has remained healthy and balanced despite increased fishing pressure and shoreline development. Therefore, based on the information presented in Section 2.4.2 that summarizes the Lake Anna fish community and its thriving populations of gamefish and the forage species that support them, the additional entrainment resulting from the operation of a new CWIS for Unit 3 would have a small impact on the fishery community and would not require mitigation.

ER Section 5.3.1.2.5, Impingement and Entrainment Implications of Options to Mitigate Increased Lake Temperature. This section is deleted since lake temperature mitigation is no longer applicable to Unit 3.

ER Section 5.3.1.2.5 will be deleted.

ER Section 5.3.2, Discharge System. This section is revised to reflect the change of "thermal discharge" to "cooling water discharge" from Unit 3. ER Section 5.3.2 will be revised to read as follows:

This section describes the impacts on Lake Anna of the discharge system during operation of the units at the ESP site. The existing temporal and spatial temperature distributions in Lake Anna and the potential physical impacts resulting from the new units' cooling water discharges are described in Section 5.3.2.1. Potential thermal, physical, and chemical stresses to aquatic organisms that may occur as a result of plant cooling system discharges via the WHTF to North Anna Reservoir are described and assessed in Section 5.3.2.2.

ER Section 5.3.2.1, Thermal Description and Physical Impacts. This section is revised to reflect the new heat load to WHTF and the reduced cooling water discharge flow rate from the closed-cycle dry and wet cooling tower system of Unit 3's circulating water system and closed-cycle wet tower system for service water system. ER Section 5.3.2.1 will be revised to read as follows:

This section discusses the thermal distribution in Lake Anna and potential physical impacts, including increased turbidity, scouring, erosion, and sedimentation in the lake resulting from the new units' cooling system discharges, noting that only Unit 3 would have blowdown discharge from its wet cooling towers during normal plant operation. The next section, Section 5.3.2.2, evaluates the aquatic impact on the lake's ecosystem. Section 5.2.1 and Section 5.2.2 describe the water use impacts of the new cooling systems. Unless site-specific data were available, the bounding design parameter values from the PPE were used as the basis for the analysis and evaluation of the new units' discharge system. Section 3.4.2 describes the physical attributes of the new discharge system.

According to the PPE, each new unit would generate, during normal full load operation, up to 1.03×10^{10} Btu/hr (10.3×10^{9} Btu/hr) of waste heat that needs to be dissipated. This heat load is in addition to the 13.54×10^{9} Btu/hr of waste heat currently permitted for discharge to the WHTF from the existing units (Reference 15). Three alternative systems are identified as technically viable options for normal plant cooling of the new units:

- A once-through system using Lake Anna as the heat sink
- A closed-cycle system with wet evaporative-type cooling towers
- A closed-cycle system with dry and wet evaporative-type cooling towers
- A closed-cycle system with air-cooled condensers or dry cooling towers

As noted in Section 3.4, Unit 3 would use a closed-cycle, dry and wet cooling tower system, whereas Unit 4 would use a closed-cycle system with dry cooling towers for the circulating water system during normal station operation. A separate, service water cooling system would utilize a closed-cycle wet cooling tower system for Unit 3 and a dry cooling tower system for Unit 4 for dissipation of waste heat from auxiliary heat exchangers not cooled by the unit's circulating water system. The blowdown effluent from Unit 3's wet cooling towers of both the circulating water and service water systems would discharge to the WHTF, but Unit 4 would have no cooling discharges and therefore no associated heat load released to the WHTF. Due to the small discharge flow rate of no greater than 12.4 cfs and small heat load on the order of 4.2×10^{7} Btu/hr during extreme summer months (Reference 3.4.1.1) that would be

associated with the blowdown discharge from the wet towers, the circulating water and service water cooling systems of Unit 3 would have very small, if not imperceptible, physical, chemical, biological or ecological impacts to Lake Anna.

The UHS for each unit would dissipate decay heat of up to 1.2×10^8 Btu/hr during normal conditions, and 4.2×10^8 Btu/hr during shutdown or accident conditions. A blowdown flow of 0.3 cfs (normal) to 1.9 cfs (maximum) per unit would be discharged to the WHTF if a plant was in UHS mode, but the heat load associated with this discharge would be very small, with its impact bounded by the normal plant cooling discharge of Unit 3. No thermal analysis was conducted specifically for the UHS discharge. The following discussion pertains to the thermal impacts on the lake due to normal plant cooling only.

ER Section 5.3.2.1.1, Existing Hydrothermal Condition. This section is revised to reflect the minor changes of the long term average inflow to the lake and the long term average outflow from the lake with existing units operating only, and to describe the very small heat load that would be added to the WHTF from the closed-cycle wet cooling towers of Unit 3. The 1st, 2nd, 4th, and 8th paragraphs of ER Section 5.3.2.1.1 will be revised to read as follows:

The existing units each have a reactor core power level of 2893 MWt (uprated in 1986) and an expected gross electrical output of about 982 MWe (Reference 1), rejecting a waste heat load of about 1911 MW (6.5×10^9 Btu/hr) per unit to the condenser cooling system for dissipation. The total heat load to the existing heat dissipation system is, therefore, below the current VPDES permit limit of 13.54×10^9 Btu/hr (Reference 15). The existing units use a once-through cooling system to dissipate the waste heat from the turbine condensers and from the auxiliary cooling systems. When both units are operating, eight circulating water pumps draw water to the plant from the North Anna Reservoir at a design rate of 4246 cfs (2123 cfs per unit). The cooling water, at a design temperature rise of about 14°F above the water temperature at the intake, is discharged through rectangular tunnels to an outfall structure at the head of the WHTF discharge channel. The actual temperature rise across the condensers may be greater or less than 14°F, depending on the power station load and the number of circulating water pumps operating. For instance, at lower condenser flow rates with three circulating water pumps running per unit rather than four, the temperature increase across the condenser averages approximately 18.3°F. A minimum of three circulating water pumps is required for each operating unit in the summer months when the intake temperature exceeds 75°F. (Reference 16)

In the WHTF, the heated effluent flows through a series of ponds and connecting canals, and returns to the North Anna Reservoir via a 6-bay skimmer wall submerged structure at Dike 3. Each discharge bay can be adjusted to maintain the discharge velocity at about 7 fps to promote mixing with the receiving water. Although the discharge is submerged, the slope of the reservoir bottom immediately adjacent to the Dike 3 discharge structure directs the discharge to the surface. (Reference 16)

Station pumping normally dominates the flow pattern and forces the majority of the cooling water flow to circulate back to the intake, because the cooling water flow rate is much higher than the average inflow to the lake and outflow at the dam. The average inflow to the lake including surface runoff, direct precipitation, and

groundwater flow is estimated to be about 369 cfs (Section 5.2.1). The average outflow at the dam varies and is estimated to be about 276 cfs when the existing units are in operation (see Section 5.3.1.1). Waste heat is transferred to the atmosphere mostly by evaporation, conduction, and back radiation. Only a small percentage of waste heat is released downstream via the North Anna Dam. It is estimated that, with the existing units operating, the cooling water's residence time in the WHTF is approximately 7 days, where about half of the waste heat is dissipated. The remaining waste heat is dissipated to the atmosphere from the North Anna Reservoir surface.

The stratification pattern in the lake would not change with the addition of new units. The thermal plume and the hypolimnion would be the same as a consequence of the very small flow and heat load added to WHTF by the new units.

ER Section 5.3.2.1.2, Hydrothermal Analysis and Thermal Prediction. This section is revised to reflect the small heat load that would be discharged from the closed-cycle wet cooling towers of the new units to the discharge canal and the associated negligible temperature impact on WHTF and North Anna Reservoir. The title and content of ER Section 5.3.2.1.2 will be revised to read as follows:

The maximum heat load associated with the new units for release to WHTF during normal operation would be very small, on the order of 4.2×10^7 Btu/hr during the extreme summer months when the wet-bulb temperature is close to 80°F, and the lake temperature is in the mid-80°F range. Compared to the total design heat load of up to 1.35×10^{10} Btu/hr from the normal plant once-through cooling system of Units 1 and 2, the new units would add about 0.3% of heat content to the WHTF during these summer months. As the cooling tower blowdown from Unit 3 exits through the new outfall at the beginning of the discharge canal, it will mix with the cooling water discharge of Units 1 and 2 from the existing outfall nearby. Using a maximum blowdown flow rate of 12.4 cfs and discharge temperature of 100°F for Unit 3, and a total circulating water discharge flow rate of 4246 cfs and a condenser temperature rise of 14°F for the existing units, the water temperature increase due to the new units is estimated to be less than a hundredth of a degree Fahrenheit at the end of the discharge canal where fully mixed condition of the two flow streams would be expected. This is based on an ambient lake temperature of 85°F during the summer months when the thermal impact would be most critical. In the cooler months when the lake temperature is lower in the 60°F range, a conservative estimate of the heat load associated with the new units would increase to about 1.1×10^8 Btu/hr due to the potentially higher temperature difference between the ambient lake water and the blowdown flow. The corresponding water temperature increase at the end of the discharge canal due to the new units would be less than a tenth of a degree Fahrenheit in the cooler months. The small water temperature increase due to the new units would dissipate to an undetectable level within a short distance of travel in the WHTF. The North Anna Reservoir would therefore experience no thermal impact as a result of the proposed operation of the new units.

Section 5.3.2.2 presents the potential impact on the aquatic ecological system of the North Anna Reservoir due to the additional heat load from the new units.

ER Section 5.3.2.1.3, Other Physical Impacts. This section is revised to reflect the small impact from the maximum blowdown discharge rate of 12.4 cfs from the closed-cycle wet towers of the new units. ER Section 5.3.2.1.3 will be revised to read as follows:

Section 5.3.1.1 discusses the hydrodynamics and the flow distribution induced in the North Anna Reservoir with the addition of new units. The conclusion is that with the small water demand from the new units, the impacts, such as increased shoreline erosion, lakebed scouring, and turbidity levels, due to the operation of the new intake system would be negligible.

The flow velocity in the discharge channel, the connecting canals, and the main ponds of the WHTF would be slightly higher than in the North Anna Reservoir due to their smaller dimensions. Unit 3 would release a maximum of 12.4 cfs of blowdown discharge to WHTF and Unit 4 would use a closed-cycle system with dry cooling towers that would have no blowdown discharges. Including the cooling water discharge of 4246 cfs from the existing units, the total maximum plant cooling discharge to the WHTF would be 4258 cfs, which represents an increase in the velocity in the WHTF by about 0.3%. During the existing operation of Units 1 and 2, scouring and erosion have not been a concern in the WHTF where the flow velocity is typically less than 1 fps. The small increase in flow and velocity due to the new units would therefore not cause any scouring or erosion problems in the lake.

Banks of the connecting canals are currently protected by rip-rap from 242 ft msl to 250 ft msl to protect against erosion. The flow velocity slows substantially in the main ponds of the WHTF beyond the entrance-mixing zone near the end of the connecting canals. At the Dike 3 discharge to the reservoir, the exit velocity is designed to be about 7 fps. The bottom of the discharge structure is protected by a concrete apron to minimize local erosion at the discharge, as shown in Figure 3.4-9. No adverse impact due to scouring from the existing plant discharge has occurred, and none would occur as a result of the future combined operation of four units.

There is limited record of turbidity level measurements in the WHTF, but based on the projected discharge flow velocity, the range of the turbidity level in the WHTF would be approximately the same as current turbidity.

Siltation would be minimal, because the medium to coarse sediment would settle before reaching the intake approach channel during normal lake conditions. Sediment could come into the approach channel during floods and deposit there due to the low channel velocity. Operation of the new intake, however, would not be affected because the channel is 12 feet deeper than the design invert of the new

intake, allowing room for occasional sediment deposition. A small amount of fine, suspended sediment could be entrained into the new intake structure and would either be filtered out during water treatment processes or be returned to the North Anna Reservoir via WHTF as part of the plant effluent from the cooling systems. Regular maintenance dredging would not be necessary for the operation of the new units.

ER Section 5.3.2.1.4, Lake Anna Cooling Pond Model. This section is deleted as the cooling pond model was used to evaluate the thermal impact of new once-through units only. With the change of cooling system from once-through for Unit 3 to closed-cycle dry and wet for circulating water and wet towers for service water, the thermal impact assessment was described in Section 5.3.2.1.2. ER Section 5.3.2.1.4 will be deleted.

5.3.2.1.4 **Lake Anna Cooling Pond Model** – Deleted

ER Section 5.3.2.2.2, Aquatic Ecosystem Impacts: Unit 3 Using a Once-through Cooling System. This section is revised to reflect significantly less physical, chemical, and thermal effects on aquatic ecosystems due to greatly reduced discharge flows. The title and subparagraphs a., b., and c. will be revised to read as follows:

5.3.2.2.2 Aquatic Ecosystem Impacts: Unit 3 Using Dry and Wet Cooling Towers

a. **Physical effects**

The NRC has queried utilities and regulatory agencies and reviewed operational monitoring reports of more than 100 nuclear power plants in the course of preparing the Generic Environmental Impact Statement for License Renewal of Nuclear Plants (GEIS). With regard to physical effects (scouring, sediment transport, and siltation), the NRC has observed in the GEIS that sediment scouring has caused "minor localized effects" at three operating plants, but has not been a problem at most plants. (Reference 19)

The addition of a new Unit 3 at NAPS using a closed-cycle, dry and wet cooling tower system to the existing once-through units would have almost no effect on circulating water discharge flows. The increase in discharge flow would range from 0.2 percent (the MWC mode maximum blowdown rate of 3,844 gpm added to two-unit, open-cycle flow of approximately 1,900,000 gpm) to 0.6 percent (maximum blowdown rate of 5,565 gpm added to one-unit, open-cycle flow of approximately 950,000 gpm). Discharge flow would range from 3,844 gpm (Units 1 and 2 off line; Unit 3 operating and discharging blowdown at maximum MWC mode rate) to 1,905,565 gpm (Units 1, 2, and 3 operating; Unit 3 discharging blowdown at maximum rate). An increase in circulating water flow of this magnitude would have no discernible effect on the substrate of the discharge canal or Waste Heat Treatment Facility and would have no impact at the Dike 3 discharge, the VPDES point of compliance. Impacts to aquatic organisms would be negligible, and mitigation would not be warranted.

b. **Chemical effects**

Nuclear power plants use a variety of chemicals, including biocides, corrosion inhibitors, and dispersants to control biofouling, corrosion, and scale formation in circulating and service water systems. For North Anna, the use of these chemicals is regulated and monitored under the VPDES permit, which prescribes their use (i.e., frequency, concentrations, and limits) and their

monitoring frequency (i.e., continuous, daily, or monthly monitoring). Because of continuing efforts of utilities to reduce the use of these chemicals and required NPDES monitoring and reporting, water quality degradation from cooling water system chemicals used in once-through cooling systems at nuclear power plants has not been a major regulatory concern. The GEIS notes that "...water quality effects of [the] discharge of chlorine and other biocides are considered to be of small significance for all plants" (Reference 19). NAPS submits monthly discharge monitoring reports to the VDEQ, which administers the Commonwealth's VPDES program. In addition, on a 5-year cycle, VDEQ conducts an extensive review of the effectiveness of existing VPDES programs, ensuring that water treatment systems in place adequately protect aquatic communities.

The GEIS notes (p 4-11) that discharges of sanitary wastes are regulated by NPDES permit, and discharges that do not violate the permit limits "are of small significance." Similarly, the GEIS notes (p 4-11) that water quality impacts of minor chemical discharges and spills do not have a significant impact on aquatic biota for all plants and have been mitigated as needed. NAPS has not had a pattern of permit exceedances or violations, and there is no basis for predicting that operation of an additional unit with cooling towers would increase the frequency or severity of VPDES permit exceedances.

Sewage treatment capacity may increase to accommodate additional on-site personnel. Any modification or expansion of existing sewage treatment facilities would be made in consultation with VDEQ, and any discharges from new or expanded facilities would comply with VPDES permit limits.

Adding a new Unit 3 with cooling towers to the two existing units would result in the discharge of cooling tower blowdown with concentrations of chemical constituents and solids that are approximately five times higher than those in water withdrawn from Lake Anna for make-up. However, this blowdown would mix with circulating water flow in the discharge canal and be further diluted downstream in the WHTF.

Based on five cycles of concentration in cooling towers and the design blowdown flow, concentrations of lake water chemicals and solids would approach equilibrium (i.e., their concentration in circulating water) at the point at which the discharge canal enters the first pond of the WHTF. Concentrations of chemicals and solids would be below applicable VPDES permit limits at the point of compliance, the Dike 3 discharge. Impacts of chemicals in cooling tower

blowdown on Lake Anna's aquatic communities would be small and would not warrant mitigation.

Metals such as copper and zinc, leached from condenser tubing and other heat exchangers, have accumulated in some water bodies receiving discharges from nuclear plants (Reference 19). Concentrations of metals in the discharges of once-through nuclear power plants are normally within NPDES permit limits, because the metals are quickly flushed from the area by the large volumes of cooling water or diluted by the receiving water (Reference 19). Concentrations of metals in the NAPS discharge are regulated by VPDES permit. There has been no pattern of exceedances or permit violations at NAPS.

Notwithstanding the fact that mining operations discharging to the Contrary Creek drainage have resulted in elevated concentrations of metals in some Lake Anna surface water and sediment samples in the past, there is no evidence of adverse impacts to aquatic communities. An additional unit with cooling towers would not result in additional impacts because discharges would continue to be regulated by the VPDES permit and thus be protective of aquatic biota. The impacts of chemicals associated with the operation of an additional unit with cooling towers on aquatic resources of Lake Anna would be small, regulated by VPDES permit, and would not warrant mitigation.

c. **Thermal effects**

1. **Thermal effects on important species**

Cold shock occurs when aquatic organisms that have been acclimated to warm water, such as fish in a power plant's discharge canal, are exposed to a sudden temperature decrease. This sometimes occurs when single-unit power plants shut down suddenly in winter. It is less likely to occur at a multiple-unit plant, because a sudden temperature decrease is moderated by the heated discharge from the unit or units that continue to operate. Cold shock mortalities at U.S. nuclear power plants are "relatively rare" and typically involve small numbers of fish (Reference 19).

There have been "winter kills" of fish in Lake Anna associated with cold weather and unusually cold water temperatures, but plant operations were not a factor. In February and March 1979, large numbers of gizzard shad were killed or stunned when Lake Anna water temperatures fell below 36°F (Reference 4). These fish drifted into the existing units' intake, and were observed in impingement samples. Limited threadfin shad kills have

occurred during severe winters. The susceptibility of gizzard shad and threadfin shad to winter kills is well known.

The temperature of cooling tower blowdown from Unit 3 would be approximately the same as the temperature of the circulating water entering the WHTF from the two existing once-through units during the summer months. As noted previously, a new Unit 3 utilizing a closed-cycle, dry and wet cooling tower system would contribute very little to discharge flow (less than one percent of total, when discharging blowdown) and would have almost no effect on discharge temperatures. The maximum temperature of cooling tower blowdown entering the discharge canal would be 100°F (Table 3.1-9). Over a recent three-year period that encompassed a severe drought, maximum temperatures recorded at the discharge canal with once-through units in operation ranged from 98.6°F in July 2000 (Reference 10) to 102.4°F in August 2002 (See Table 5.3-9). Based on the fact that blowdown from new Unit 3 would have negligible effect on temperatures in the WHTF, thermal impacts to aquatic organisms in the WHTF from operation of a third unit would be negligible, and would not warrant mitigation. Similarly, blowdown from Unit 3 would have no effect on temperature in Lake Anna and no impact on aquatic communities.

2. **Thermal effects on nuisance species**

Densities of the introduced Asiatic clam (*Corbicula fluminea*) in Lake Anna increased from 1979 (when first discovered) to the late 1980s, and declined in the 1990s (see Section 2.4.2). As discussed in the previous sections, operation of a third unit with a closed-cycle, dry and wet cooling tower system would have negligible effect on discharge temperatures, and thus there would be no thermal impact on nuisance species including the introduced Asiatic clam.

ER Section 5.3.2.2.3, Aquatic Ecosystem Impacts: Unit 3 Using Once-through Cooling and Unit 4 Using Dry Towers. This section is revised to reflect the significantly reduced effect of cooling tower operation on aquatic ecosystems. The title and subparagraphs a., b., and c. will be revised to read as follows:

5.3.2.2.3 Aquatic Ecosystem Impacts: Unit 3 Using Dry and Wet Cooling Towers and Unit 4 Using Dry Towers

a. **Physical effects**

The addition of a new Unit 4 using dry cooling towers to the two existing units and a new unit (Unit 3) with a combination of dry and wet towers would contribute very little to circulating water discharge flows and would have no appreciable effect on substrate in the discharge area or the Dike 3 discharge beyond those described in Section 5.3.2.2.2.a for two once-through units and one unit with a combination of dry and wet cooling towers. Physical impacts to aquatic communities would be small, and would not warrant mitigation.

b. **Chemical effects**

The dry cooling tower system proposed for Unit 4 would employ a closed loop of cooling water and, unlike wet cooling towers, would not require regular blowdown of water treatment chemicals and solids. Consequently, there would be no appreciable discharges of water treatment chemicals, biocides, salts, or other solids from the Unit 4 cooling systems, and no chemical effects on the aquatic communities of the WHTF and Lake Anna beyond those described in Section 5.3.2.2.2.b for two once-through units and one unit with a combination of dry and wet cooling towers. Chemical impacts would be small and would not warrant mitigation.

c. **Thermal effects**

As noted previously, a new unit (Unit 4), using dry towers would have no regular discharges (i.e., blowdown) and would have no appreciable affect on discharge temperatures beyond those already described in Section 5.3.2.2.2.c for the two existing units (Units 1 and 2) with once-through cooling systems and the new unit (Unit 3) with a closed-cycle, cooling tower-based system.

ER Section 5.3.2.2.4, Implications of Mitigation Options. This section is deleted since mitigation options are no longer required with cooling towers.

ER Section 5.3.2.2.4 will be deleted.

ER Section 5.3.3, Heat-Discharge System. This section is revised to identify that a closed-cycle, combination dry and wet tower system would be used for Unit 3 and that the cooling system discharges from both the existing units and the new wet cooling tower system blowdown would be sent via discharge canal to the existing WHTF. ER Section 5.3.3 will be revised to read as follows:

This section describes the impacts of the heat-discharge system during operation of the new units, including the impacts of heat dissipation on the atmosphere and on terrestrial ecosystems. Impacts of the heat-discharge system have been assessed assuming that Unit 3 would use a closed-cycle, dry and wet cooling tower system. All cooling system discharges for both the existing units and the new Unit 3 cooling tower system blowdown would be sent via discharge canal to the existing WHTF and the North Anna Reservoir for heat dissipation, while Unit 4 would use closed-cycle dry cooling towers for heat dissipation. Consideration is given to potential atmospheric phenomena resulting from operation of these types of heat-dissipation systems and the significance of their potential environmental impacts on terrestrial ecosystems and human activities in the ESP site vicinity.

ER Section 5.3.3.1, Heat Dissipation to the Atmosphere. This section is revised to identify that closed-cycle, combination dry and wet cooling towers would be used to dissipate plant rejected heat for Unit 3 and that additional heat dissipation from Unit 3 blowdown to WHTF is negligible when compared to the heat dissipated from the existing units. This section is further revised to discuss plume, salt drift and steam fog from Unit 3 wet cooling. ER Section 5.3.3.1 will be revised to read as follows:

The cooling system options that have been evaluated for the new units would transfer waste heat from the plant components to the atmosphere and to surface water. A closed-cycle, dry and wet cooling tower system is the primary cooling process evaluated for Unit 3. Lake Anna would provide the make-up water to wet cooling towers. Unit 4 cooling would be provided by closed-cycle dry towers to transfer heat to the atmosphere.

Specifically, new Unit 3 would use the existing North Anna Reservoir as the make-up water supply source and the wet cooling tower blowdown would be discharged to the WHTF. A cooling system analysis was performed as described in Section 3.4. The WHTF dissipates the rejected heat from the plant by heat transfer to the atmosphere and through internal mixing within the water body itself. Under extreme humidity conditions during fall, winter, and spring; cool moist air above the WHTF could turn to fog (i.e., steam fog) and drift to adjacent areas. Any steam fog impact from Unit 3 would be small since the additional heat dissipated by Unit 3 blowdown is very small and negligible when compared to the heat dissipated from the existing Units. Also, this type of atmospheric phenomena tends to impact ground level visibility in a very localized area. Additionally, the results from screening 5 years (1996–2000) of hourly meteorological data collected at Richmond, Virginia, indicate that there were no hours concurrently having relative humidity greater than 90 percent and ambient temperature below 32°F. Therefore, steam-fog-induced icing conditions are very infrequent at the site. Consequently, ice buildup on transmission lines, switchyard, insulators and structures due to steam fog would not be anticipated.

A combination of dry and wet towers would be used to dissipate plant rejected heat for Unit 3. Dry towers alone would be used to dissipate all of plant rejected heat for Unit 4. Except for the initial filling of the cooling water loop, there will be no appreciable additions of make-up water since a closed-cycle dry cooling system typically has no evaporative losses or need for continuous blowdown. Therefore, the operation of closed-cycle dry towers for Unit 3 and Unit 4 would not produce a visible plume, salt drift, or steam fog. Operation of the wet cooling towers may produce a visible plume, salt drift and steam fog. Salt deposition rates would be below the

threshold value of 1 kg/ha/month beyond the site boundary at ground levels. Certain components located outdoors and in the proximity of the Unit 3 wet cooling towers could potentially be affected by fogging or by salt deposition from drift from the towers. In a COL application, when a specific reactor design is selected, a more detailed evaluation would be made of the fogging and salt deposition, and specific design consideration would be given to mitigate the effects of these phenomena or to eliminate them from occurring. Most of the fogging from the wet cooling towers would occur within the site boundary in winter and spring. No icing would be anticipated within or beyond the site boundary. Industry standard techniques would be implemented during final design phase to limit fogging to be within reasonable levels.

Section 3.4.1.1 contains a detailed description of the operation of the closed-cycle dry and wet cooling towers. As ambient air is drawn over sealed piping containing heated water, excess heat is transferred to the air through conduction and convection. In wet towers, heat from the water is transferred to the air by allowing a small portion of the water to evaporate thus raising the water temperature and relative humidity. The heated air from the dry and wet towers is then released to the atmosphere where it mixes and is entrained into the surrounding air mass. The mixture of heated air would continue to rise while it is transported downwind. Additional mixing with cooler air outside would further lower the temperature of the mixture. Therefore, any increases in overall atmosphere temperature would be localized to the NAPS site, and would not affect the atmospheric or ground temperatures beyond the NAPS site boundary.

ER Section 5.3.3.2, Terrestrial Ecosystems. This section is revised reflect the change to closed-cycle, dry and wet towers for Unit 3. The 2nd paragraph of ER Section 5.3.3.2 will be revised to read as follows:

No important terrestrial species or habitats exist within the vicinity of the closed-cycle, dry and wet towers for Unit 3 and the closed-cycle dry towers for Unit 4. Important species are defined as follows:

- State- or federally-listed (or proposed for listing) threatened or endangered species
- Commercially or recreationally valuable species
- Species that are essential to the maintenance and survival of species that are rare and commercially or recreationally valuable
- Species that are critical to the structure and function of the local terrestrial ecosystem
- Species that may serve as biological indicators to monitor the effects of the facilities on the terrestrial environment

ER Section 5.3.3.2.1, Salt Drift, Vapor Plumes, and Icing. This section is revised to note no significant icing, fogging, or salt deposition as a result of cooling tower operation. ER Section 5.3.3.2.1 will be revised to read as follows:

As concluded in Section 5.3.3.1, steam fog formation, drift and steam-fog-induced icing conditions resulting from operation of the WHTF are very localized and infrequent at the NAPS site. Also, no significant icing would be anticipated from operation of wet cooling towers. Salt deposition from operation of wet cooling towers would be below the threshold value of 1 kg/ha/month beyond the site boundary at ground level. Most of the fogging would occur within the site boundary. Since no important terrestrial species or habitats exist within the vicinity of Unit 3, any steam fog, drift and icing impacts resulting from operation of the WHTF and wet cooling towers on the local terrestrial ecosystems would be small.

As presented in Section 5.3.3.1, there are no evaporative losses associated with the operation of closed-cycle dry cooling systems. Therefore, dry cooling tower operation for Units 3 and 4 would pose no impacts from salt drift, salt deposition, vapor plumes, or icing.

ER Section 5.3.3.2.2, Local Temperature Increases. This section is revised to note that atmospheric temperature increases due to wet cooling tower operation are expected to be localized and non-impacting on terrestrial ecosystems. ER Section 5.3.3.2.2 will be revised to read as follows:

As presented in Section 5.1.1.2, sensible atmospheric temperature increases resulting from operation of the dry and wet cooling towers are expected to be very localized near the tower location and would not extend beyond the NAPS site boundary. Impacts to vegetation near the towers would be minimal and could be viewed as beneficial due to the potential for encouraging vegetation growth in the colder seasons of the year. There are no expected impacts, adverse or beneficial, to terrestrial ecosystems beyond the NAPS site boundary from atmospheric temperature increases due to operation of the dry towers for Unit 3 or Unit 4.

ER Section 5.3.3.2.4, Avian Collisions. This section is revised to note that the new towers would not affect flying birds. ER Section 5.3.3.2.4 will be revised to read as follows:

A combination of dry and wet cooling towers with an overall height of less than 80 feet would be used for the Unit 3 heat dissipation system. Dry towers with an overall height of 150 feet would be used for the Unit 4 heat dissipation system. No avian collisions with existing NAPS structures have been noted, and it is likely that bird collisions with the new towers would be rare. Therefore, the new towers would not adversely affect flying birds. Impacts to birds from collisions with heat dissipation structures would be small and would not warrant mitigation. The GEIS conclusion that impacts from bird collisions would be minimal (Reference 19) is valid for new units at the ESP site.

ER Section 5.3.4, Impacts to Members of the Public. This section is revised to note that the thermal effects on the WHTF due to the new cooling system would be negligible. The 2nd and 5th paragraphs of Section 5.3.4 will be revised to read as follows:

The existing units use an open-cycle cooling system which withdraws cooling water from the North Anna Reservoir and returns heated effluent to the WHTF. The WHTF discharges to the North Anna Reservoir through Dike 3 (Reference 38). The WHTF is considered by the VDEQ to be a mixing zone for the purpose of complying with the state water quality standards under the VPDES program. Virginia Power considers the WHTF to be an integral part of the power station, and as such it has never been operated as an extension of the North Anna Reservoir for the purposes of public recreational use. However, with Virginia Power's permission, homeowners on the shoreline of the WHTF have access to it for recreational use (boating, fishing, swimming). This limited access and use would remain unchanged following the addition of the cooling systems for the new units. The WHTF would be the area most likely affected by the noise from the new cooling systems. The thermal effects on the WHTF due to the new cooling systems would be negligible.

As described in Section 3.4, the cooling needs of the new units would be provided by a closed-cycle, dry and wet tower system for Unit 3 and a closed-cycle dry tower system for Unit 4. The Unit 3 closed-cycle wet tower cooling system would have a negligible thermal impact on the WHTF. The Unit 3 closed-cycle wet towers would generate more noise. The evaluations of thermophilic organisms and noise on the public are based on the composite cooling system (i.e., closed-cycle wet tower system operating in tandem with dry towers).

ER Section 5.3.4.1, Thermophilic Micro-Organism Impacts. This section is revised to provide additional information regarding thermophilic micro-organisms and to note that there would be no significant alteration of the existing ambient temperature regime of the WHTF and the North Anna Reservoir due to the operation of cooling towers for Unit 3. ER Section 5.3.4.1 will be revised to read as follows:

NUREG-1555 and NUREG-1437 state that consideration of the impacts of thermophilic micro-organisms on public health are important for facilities using cooling ponds, lakes, canals, or small rivers, because use of such water bodies may significantly increase the presence and numbers of thermophilic micro-organisms. These micro-organisms could be causative agents of potentially serious human infections.

Thermophilic micro-organisms (e.g., *Naegleria fowleri*) generally exist in water bodies with ambient temperatures between 77°F to 176°F. However, such organisms begin to thrive especially well (compared to their competitors) at ambient temperatures above 95°F (Reference 48) and maximum growth generally occurs when ambient temperatures are maintained between 122°F and 140°F (Reference 16, Section 4.12). Since 1975, Virginia Power has monitored water temperatures at various locations in the North Anna Reservoir, the WHTF, and the discharge canal. The highest temperatures recorded are summarized in Table 5.3-9:

Table 5.3-9 Lake Anna Temperature Measurements

Date	Monitoring Station	Temperature
	Pre-Operation Period (Units 1 & 2)	
July 1977	North Anna Reservoir – Pamunkey Arm	92.7°F (hourly average)
August 1980	North Anna Reservoir – Lower Lake Station	91.6°F (hourly average)
	Operational Period (Units 1 & 2)	
Summer 1983	North Anna Reservoir	92.3°F (hourly average)
June 1984	North Anna Reservoir – Upper Lake Station	91.8°F (hourly average)
Summer Seasons 1983-1985	Dike 3 – Discharge of WHTF to North Anna Reservoir	88.2°F (monthly mean)
July 1993	Dike 3 – Discharge of WHTF to North Anna Reservoir	95.0°F (hourly average)

July 1993	Lake Anna – inlet structure	90.1°F (hourly average)
Summer Season 1997	North Anna Reservoir	86.4°F (max. recorded)
Summer Season 1997	Discharge Canal	97.7°F (max. recorded)
Summer Season 1997	WHTF	94.3°F (max. recorded)
August 2002	Discharge Canal	102.4°F (hourly average)

Data Source: Reference 15 and Reference 16, Section 4.12

While ambient summer water temperatures in the sampled locations were found to be within the range of those known to permit the reproduction and growth of pathogenic micro-organisms, the temperatures measured at all locations beyond the plant discharge to the WHTF were below those considered optimal for the growth of thermophilic forms. Temperatures in the WHTF downstream of the discharge structure were several degrees cooler than those in the immediate area of the discharge outfall and, under normal circumstances, would not create an environment especially conducive to the reproduction and growth of pathogenic micro-organisms.

Because the existing units currently discharge heated cooling water into the WHTF, and then into the North Anna Reservoir and the North Anna River, the potential impacts of thermophilic organisms have been investigated since the 1970s (Reference 16). Findings were summarized in a letter from Virginia Power to the VDH (Reference 16, Section 4.12 & Appendix F). This letter recognized Medical College of Virginia research which isolated Naegleria fowleri from a number of central-Virginia lakes, including the WHTF at the North Anna Power Plant. This amoeba, however, is ubiquitous in nature, found throughout the world, and is not just isolated to Central Virginia. Recent correspondence with Virginia Department of Health (VDH, September 2005) (Reference 48) still recognizes health risks associated with exposure to Naegleria fowleri. Dominion is working with state agencies to communicate to residents around the WHTF, information related to risk that was provided in the VDH correspondence. No cases of primary amoebic encephalitis have been documented among station workers or area residents in over 20 years since the initial discovery report (1970s).

The addition of Unit 3 wet towers would require a small amount of continuous blowdown from the closed-cycle system to WHTF but the blowdown would not have any significant effect on the temperatures of the WHTF and therefore would not contribute to an environment conducive to the optimal growth of thermophilic

organisms. Unit 3 and Unit 4 dry tower operation would pose no additional significant thermal impact to the North Anna Reservoir to support growth of thermophilic micro-organisms. The downstream North Anna River temperatures would be unaffected by the negligible increase in thermal discharge. The maximum hourly average discharge canal and WHTF water temperatures would remain below the optimal range for thermophilic micro-organism growth (see Section 5.3.2).

Another component of the risk evaluation is the source of pathogenic materials; that is, the seeds or inoculants for such organisms. Wastewater (e.g., domestic sewage from the existing units case) represents the primary potential source of water-borne pathogens. Virginia Power's upgraded onsite sewage treatment plant includes disinfection processes that reduce coliform bacteria and other micro-organisms to levels that meet state water quality standards (see Section 3.6.2). The addition of personnel to support operation of the new units would not adversely impact the performance of this upgraded treatment facility.

In summary, the thermal and wastewater discharges from the addition of new units at the ESP site would result in the following:

- No significant alteration of the existing ambient temperature regime of the WHTF and the North Anna Reservoir.
- No significant seeds or inoculants of pathogenic organisms would be present.
- No significant increases to the population of naturally occurring micro-organisms.
- No change to the Virginia State Epidemiologist's NAPS licensing renewal recommendation that no further action regarding thermophilic micro-organism impacts is warranted. (Reference 16, Appendix F)

ER Section 5.3 References.

References 18, 20-36, and 44-47 are deleted because they are only applicable for the impact assessment of the once-through cooling system previously proposed for Unit 3.

Reference 48 *(Letter from R. B. Stroube, Commonwealth of Virginia Department of Health, to R. Burnley, Commonwealth of Virginia Department of Environmental Quality, dated September 15, 2005)* **is added due to recent correspondence from the Virginia Department of Heath on thermophilic micro-organisms.**

ER Table 5.3-14, Maximum and Minimum Daily Surface Temperature at Six Locations in the WHTF and the Reservoir Based on 42-years of Model Prediction from January 1961 to May 2003. This table is deleted because the contents are only applicable if Unit 3 would use a once-through cooling system.

ER Table 5.3-14 will be deleted.

ER Table 5.3-15, Mean Surface Temperature and Mean Surface Temperature During July and August at Six Locations in the WHTF and the North Anna Reservoir Based on 42-years of Model Prediction from January 1961 to May 2003. This table is deleted because the contents are only applicable if Unit 3 would use a once-through cooling system.

ER Table 5.3-15 will be deleted.

ER Table 5.3-16, Exceedence Frequency of Daily Surface Temperatures at Six Locations in the WHTF and the North Anna Reservoir Based on 42-years of Model Prediction from January 1961 to May 2003. This table is deleted because the contents are only applicable if Unit 3 would use a once-through cooling system.

ER Table 5.3-16 will be deleted.

ER Table 5.3-17, Predicted Maximum Daily Surface Temperature Increase Due to One and Two New Once-through Cooling System Units On the Lake. This table is deleted because the contents are only applicable if the new units would use a once-through cooling systems.

ER Table 5.3-17 will be deleted.

ER Table 5.3-18, North Anna Cooling Pond Model Areas. This table is deleted because the contents are not applicable since the cooling pond model was not used to evaluate the thermal impact of the new units.

ER Table 5.3-18 will be deleted.

ER Table 5.3-19, Average Daily Water Temperatures at Burrus Point with 3-Unit Operation. This table is deleted because the contents are only applicable if Unit 3 would use a once-through cooling system.

ER Table 5.3-19 will be deleted.

ER Table 5.3-20, Average Daily Water Temperatures at Thurman Island with 3-Unit Operation. This table is deleted because the contents are only applicable if Unit 3 would use a once-through cooling system.

ER Table 5.3-20 will be deleted.

ER Table 5.3-21, Average Daily Water Temperatures in Intake Area with 3-Unit Operation. This table is deleted because the contents are only applicable if Unit 3 would use a once-through cooling system.

ER Table 5.3-21 will be deleted.

ER Table 5.3-22, Temperature (°F) Requirements of Important Fish Species of Lake Anna. This table is deleted because the contents are only applicable if Unit 3 would use a once-through cooling system.

ER Table 5.3-22 will be deleted.

ER Figure 5.3-2, Intake Structure and Approach Channel for the New Units and the Existing Units. The figure shows a smaller intake structure and a revised approach channel due to the change to closed-cycle cooling. ER Figure 5.3-2 will be revised as follows:

[See next page]

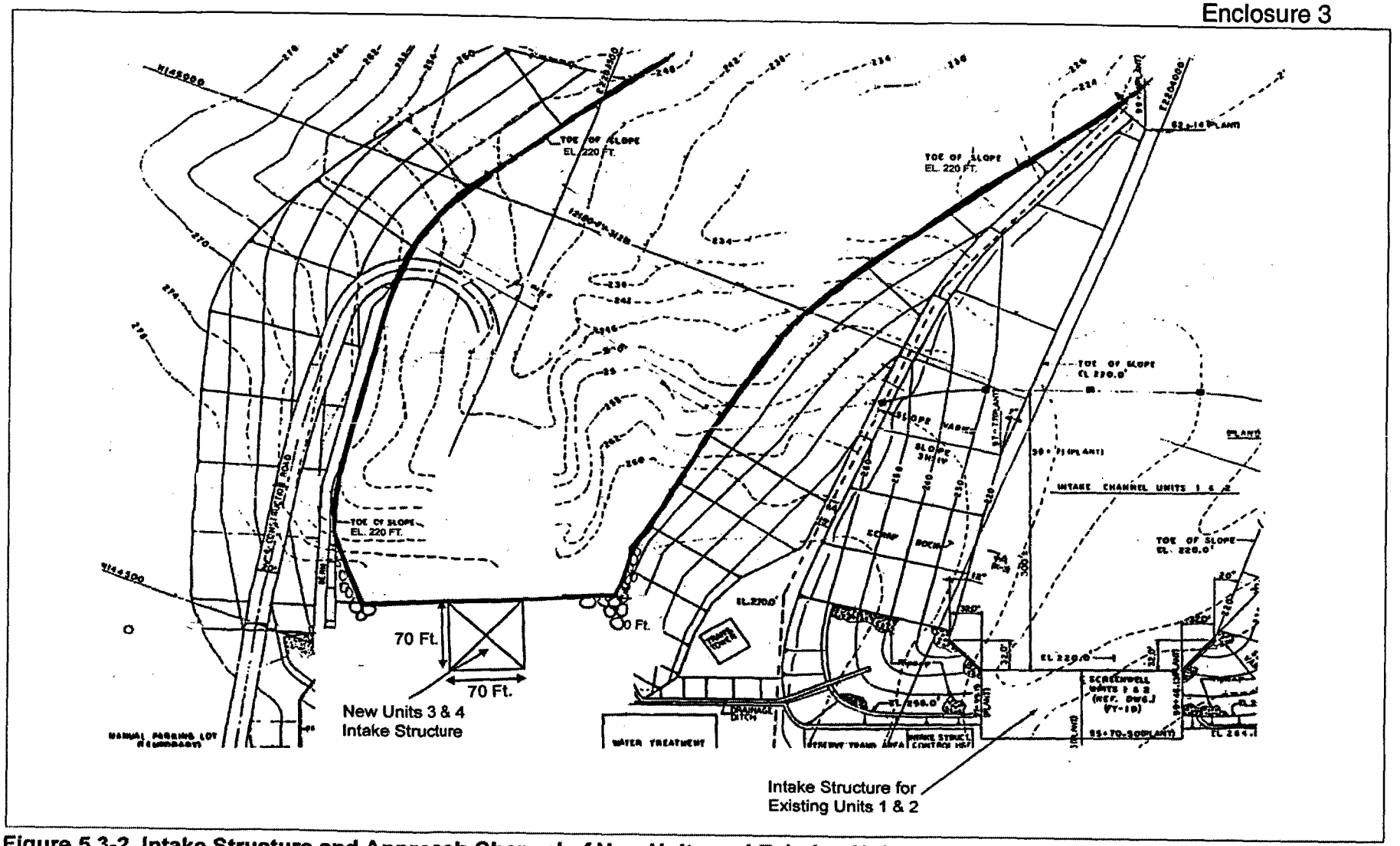


Figure 5.3-2 Intake Structure and Approach Channel of New Units and Existing Units

ER Table 5.4-6, Release of Activities in Liquid Effluent. To reflect scaling up to the ESBWR core thermal power of 4500 MWt, the ABWR activities in ER Table 5.4-6 will be revised to read as follows:

Table 5.4-6 Release of Activities in Liquid Effluent

Isotope	Release (Ci/yr)	Isotope	Release (Ci/yr)	Isotope	Release (Ci/yr)	Isotope	Release (Ci/yr)
C-14	4.4E-04	Rb-88	2.7E-04	Ru-106	7.4E-02	Cs-134	9.9E-03
Na-24	3.2E-03	Rb-89	5.0E-05	Rh-103m	4.9E-03	Cs-136	6.3E-04
P-32	2.1E-04	Sr-89	1.3E-04	Rh-106	7.4E-02	Cs-137	1.3E-02
Cr-51	8.8E-03	Sr-90	4.0E-05	Ag-110m	1.1E-03	Cs-138	2.2E-04
Mn-54	3.0E-03	Sr-91	1.0E-03	Ag-110	1.4E-04	Ba-137m	1.2E-02
Mn-56	4.4E-03	Sr-92	9.2E-04	Sb-124	6.8E-04	Ba-140	5.5E-03
Fe-55	6.7E-03	Y-90	3.6E-06	Te-129m	1.2E-04	La-140	7.4E-03
Fe-59	2.0E-04	Y-91m	1.0E-05	Te-129	1.5E-04	Ce-141	1.4E-04
Co-56	5.9E-03	Y-91	1.3E-04	Te-131m	9.0E-05	Ce-143	1.9E-04
Co-57	8.2E-05	Y-92	6.9E-04	Te-131	3.0E-05	Ce-144	3.2E-03
Co-58	3.4E-03	Y-93	1.0E-03	Te-132	2.4E-04	Pr-143	1.3E-04
Co-60	1.0E-02	Zr-95	1.0E-03	I-131	1.4E-02	Pr-144	3.2E-03
Ni-63	1.6E-04	Nb-95	1.9E-03	I-132	3.0E-03	W-187	1.3E-04
Cu-64	8.6E-03	Mo-99	9.5E-04	I-133	1.1E-02	Np-239	3.6E-03
Zn-65	4.1E-04	Tc-99m	9.2E-04	I-134	1.9E-03	Total w/o H-3	3.2E-01
Br-84	2.0E-05	Ru-103	4.9E-03	I-135	8.6E-03	H-3	3.1E+03

Note:These composite values are somewhat different than those in Table 3.1-7 because these reflect ABWR/ESBWR releases at an uprated power level of 4500 MWth.

ER Table 5.4-7, Release of Activities in Gaseous Effluent. To reflect scaling up to the ESBWR core thermal power of 4500 MWt, the ABWR activities in ER Table 5.4-7 will be revised to read as follows:

Table 5.4-7 Release of Activities in Gaseous Effluent

Isotope	Release (Ci/yr)	Isotope	Release (Ci/yr)	Isotope	Release (Ci/yr)	Isotope	Release (Ci/yr)
H-3	3.5E+03	Kr-85	4.1E+03	Ru-103	4.0E-03	Xe-135m	4.6E+02
C-14	1.1E+01	Kr-87	2.9E+01	Rh-103m	1.3E-04	Xe-135	5.3E+02
Na-24	4.6E-03	Kr-88	4.6E+01	Ru-106	7.8E-05	Xe-137	5.9E+02
P-32	1.1E-03	Kr-89	2.8E+02	Rh-106	2.2E-05	Xe-138	5.0E+02
Ar-41	3.0E+02	Kr-90	3.7E-04	Ag-110m	2.3E-06	Xe-139	4.6E-04
Cr-51	4.0E-02	Rb-89	5.0E-05	Sb-124	2.1E-04	Cs-134	7.1E-03
Mn-54	6.2E-03	Sr-89	6.5E-03	Sb-125	6.1E-05	Cs-136	6.8E-04
Mn-56	4.0E-03	Sr-90	1.2E-03	Te-129m	2.5E-04	Cs-137	1.1E-02
Fe-55	7.4E-03	Y-90	5.3E-05	Te-131m	8.7E-05	Cs-138	1.9E-04
Co-57	8.2E-06	Sr-91	1.1E-03	Te-132	2.2E-05	Ba-140	3.1E-02
Co-58	2.3E-02	Sr-92	9.0E-04	I-131	3.0E-01	La-140	2.1E-03
Co-60	1.5E-02	Y-91	2.8E-04	I-132	2.5E+00	Ce-141	1.1E-02
Fe-59	9.3E-04	Y-92	7.1E-04	I-133	1.9E+00	Ce-144	2.2E-05
Ni-63	7.4E-06	Y-93	1.3E-03	I-134	4.3E+00	Pr-144	2.2E-05
Cu-64	1.1E-02	Zr-95	1.8E-03	I-135	2.8E+00	W-187	2.2E-04
Zn-65	1.3E-02	Nb-95	9.6E-03	Xe-131m	1.8E+03	Np-239	1.4E-02
Kr-83m	9.6E-04	Mo-99	6.8E-02	Xe-133m	8.7E+01	Total	1.7E+04
Kr-85m	3.6E+01	Tc-99m	3.4E-04	Xe-133	4.6E+03		

Isotope	Release (Ci/yr)	Isotope	Release (Ci/yr)	Isotope	Release (Ci/yr)	Isotope	Release (Ci/yr)

Note:These composite values are somewhat different than those in Table 3.1-8 because these reflect ABWR/ESBWR releases at an uprated power level of 4500 MWth.

ER Table 5.4-8, Liquid Pathway Doses for Maximally Exposed Individuals at Lake Anna. To reflect scaling up the ABWR source to the ESBWR core thermal power of 4500 MWt, the composite (AP1000, ABWR, and ACR-700) doses in ER Table 5.4-8 will be revised to read as follows:

Table 5.4-8 Liquid Pathway Doses for Maximally Exposed Individuals at Lake Anna

Pathway	Dose (mrem/yr)		
	Total Body	Thyroid	Liver
Fish	4.9E-01	0.0E+00	5.9E-01
Invertebrate	6.7E-02	0.0E+00	1.0E-01
Drinking	6.9E-01	1.3E+00	9.4E-01
Shoreline	3.1E-02	3.1E-02	3.1E-02
Swimming	3.1E-04	3.1E-04	3.1E-04
Boating	3.8E-04	3.8E-04	3.8E-04
Total	1.3E+00	1.3E+00	1.7E+00
Age group receiving *maximum dose*	Adult	Infant	Child

Note:Doses are from one new unit. Liver of the child is the organ receiving the maximum dose.

ER Table 5.4-9, Gaseous Pathway Doses for Maximally Exposed Individuals. To reflect scaling up the ABWR source to the ESBWR core thermal power of 4500 MWt, the composite (AP1000, ABWR, and ACR-700) doses in ER Table 5.4-9 will be revised to read as follows:

Table 5.4-9 Gaseous Pathway Doses for Maximally Exposed Individuals

Location	Pathway	Dose (mrem/yr)		
		Total Body	Thyroid	Skin
Nearest Site Boundary (0.88 mi ESE)	Plume	1.4E+00	0.0E+00	4.3E+00
	Inhalation			
	Adult	3.0E-01	1.3E+00	0.0E+00
	Teen	3.1E-01	1.7E+00	0.0E+00
	Child	2.7E-01	2.0E+00	0.0E+00
	Infant	1.6E-01	1.7E+00	0.0E+00
Nearest Garden (0.94 mi NE)	Vegetable			
	Adult	4.2E-01	3.0E+00	0.0E+00
	Teen	5.4E-01	4.0E+00	0.0E+00
	Child	1.0E+00	7.7E+00	0.0E+00
Nearest Residence (0.96 mi NNE)	Plume	9.2E-01	0.0E+00	2.8E+00
	Inhalation			
	Adult	2.0E-01	8.6E-01	0.0E+00
	Teen	2.0E-01	1.1E+00	0.0E+00
	Child	1.8E-01	1.3E+00	0.0E+00
	Infant	1.0E-01	1.1E+00	0.0E+00
Nearest Meat Cow (1.37 mi SE)	Meat			
	Adult	6.3E-02	1.1E-01	0.0E+00
	Teen	4.5E-02	7.9E-02	0.0E+00
	Child	7.2E-02	1.2E-01	0.0E+00

Note:Doses are from one new unit. There are no milk cows or goats within 5 miles (SeeTable 2.7-13). There are no infant doses for the vegetable and meat pathways because infants do not consume these foods (See Table 5.4-5).

ER Table 5.4-10, Comparison of Maximally Exposed Individual Doses with 10 CFR 50, Appendix I Criteria. To reflect scaling up the ABWR source to the ESBWR core thermal power of 4500 MWt, the composite (AP1000, ABWR, and ACR-700) doses in ER Table 5.4-10 will be revised to read as follows:

Table 5.4-10 Comparison of Maximally Exposed Individual Doses with 10 CFR 50, Appendix I Criteria

		Annual Dose per Unit	
Type of Dose	**Location**	**Calculated**	**Limit**
Liquid Effluent			
Total Body (mrem)	Lake Anna	1.3	3
Maximum Organ - Liver (mrem)	Lake Anna	1.7	10
Gaseous Effluent			
Gamma Air (mrad)	Site Boundary	2.2	10
Beta Air (mrad)	Site Boundary	3.6	20
Total Body (mrem)	Site Boundary	1.7	5
Skin (mrem)	Site Boundary	4.3	15
Iodines and Particulates (All Effluents)			
Maximum Organ - Thyroid (mrem)	Lake Anna/ Nearest Garden	8.0	15

Note:Doses are from one new unit.

ER Table 5.4-11, Comparison of Maximally Exposed Individual Doses with 40 CFR 190 Criteria. To reflect scaling up the ABWR source to the ESBWR core thermal power of 4500 MWt, the composite (AP1000, ABWR, and ACR-700) doses in ER Table 5.4-11 will be revised to read as follows:

Table 5.4-11 Comparison of Maximally Exposed Individual Doses with 40 CFR 190 Criteria

	Dose (mrem/yr)					
	Two New Units			Existing Units	Site Total	Regulatory Limit
	Liquid	Gaseous	Total			
Total Body	2.6E+00	3.5E+00	6.0E+00	3.2E-01	6.3E+00	2.5E+01
Thyroid	2.6E+00	1.5E+01	1.8E+01	4.6E-01	1.9E+01	7.5E+01
Other Organ - Bone	2.4E+00	5.9E+00	8.2E+00	4.6E-01	8.7E+00	2.5E+01

Note: Doses for existing units are from Reference 11.

ER Table 5.4-12, Collective Total Body Doses Within 50 Miles. To reflect scaling up the ABWR source to the ESBWR core thermal power of 4500 MWt, the composite (AP1000, ABWR, and ACR-700) doses in ER Table 5.4-12 will be revised to read as follows:

Table 5.4-12 Collective Total Body Doses Within 50 Miles

	Dose (person-rem/yr)	
	Each New Unit	Both Units
Liquid	1.4E+01	2.8E+01
Noble Gases	2.9E+00	5.8E+00
Iodines and Particulates	1.4E+00	2.9E+00
H-3 and C-14	1.4E+01	2.8E+01
Total	3.2E+01	6.4E+01
Natural Background	9.2E+05	9.2E+05

Note:Natural background dose is based on a dose rate of 325 mrem/person-yr (Reference 10, Table 11B-8, and Reference 12, Table 9.7) and a population of 2.8E+06 (Table 2.5-8). Occupational workforce doses are not shown.

ER Table 5.4-16, Biota Doses from Liquid and Gaseous Effluents. To reflect scaling up the ABWR source to the ESBWR core thermal power of 4500 MWt, the composite (AP1000, ABWR, and ACR-700) doses in ER Table 5.4-16 will be revised to read as follows:

Table 5.4-16 Biota Doses from Liquid and Gaseous Effluents

Biota	Dose (mrad/yr)			Dose (mrad/day)
	Liquid Effluent	Gaseous Effluent	Total	
Fish	6.9E+00	0.0E+00	6.9E+00	1.9E-02
Invertebrates	4.7E+01	0.0E+00	4.7E+01	1.3E-01
Algae	3.9E+01	0.0E+00	3.9E+01	1.1E-01
Muskrat	2.2E+01	2.8E+01	5.0E+01	1.4E-01
Raccoon	5.0E+00	2.8E+01	3.3E+01	9.1E-02
Heron	5.0E+01	2.8E+01	7.8E+01	2.1E-01
Duck	2.2E+01	2.8E+01	5.0E+01	1.4E-01

ER Section 5.5.1, Nonradioactive-Waste-System Impacts. This section is revised to reflect the presence of wet cooling tower blowdown from the Unit 3 closed cycle cooling system. The 2nd paragraph of ER Section 5.5.1 will be revised to read as follows:

All non-radioactive wastes generated at the NAPS site, including those from the new units (i.e., solid wastes, liquid wastes, air emissions) would continue to be managed in accordance with applicable federal, Virginia, local laws and regulations, and permit requirements. Management practices would be the same as those implemented for the existing units and would include the following:

- Non-radioactive solid waste (e.g., office waste, glass bottles, scrap wood) would be collected temporarily on the NAPS site and disposed of at offsite licensed commercial waste disposal site(s).
- Debris (e.g., vegetation) collected on trash screens at the water intake structure(s) would be disposed of off site as solid waste, in accordance with the existing VPDES Permit. (Reference 1)
- Scrap metal would be collected temporarily on the NAPs site and transported to an offsite permitted recycling facility.
- Water from wet cooling tower blowdown and auxiliary systems would be discharged through the WHTF to the North Anna Reservoir via Dike 3.
- Wastewater treatment sludge would be taken to the Louisa County Sewage Treatment Plant for further processing and disposal.
- Used oil and antifreeze would be collected temporarily on the NAPS site and recycled through an offsite environmental services contractor.

ER Section 5.5.1.1, Discharge Constituents and Characteristics. This section is revised to note the constituents and concentrations of wet cooling tower blowdown. The 1st and 2nd paragraphs of ER Section 5.5.1.1 will be revised to read as follows:

Non-radioactive wastewater discharges to surface water would increase as a result of several aspects of new units' operation, such as blowdown from Unit 3 wet cooling tower, new auxiliary systems, and storm water runoff from new impervious surfaces. The ESP Site Characteristics and Design Parameters Table (Table 3.1-9) lists possible water treatment chemicals that would be used for the new units, along with estimates of constituent concentrations in the cooling and auxiliary system discharges. The estimates of constituent concentrations are based on conservative assumptions of system operation (e.g., flow rates, cycles of concentration, chemical addition, etc.) and on historical data on water quality for the North Anna Reservoir (the source of cooling tower make-up). Section 3.6 contains information regarding the engineering controls that would prevent or minimize the release of harmful levels of constituents to Lake Anna. Concentrations of constituents in the cooling tower blowdown water discharge would be minimal or non-detectable in the North Anna Reservoir (see Section 5.3.2.2).

Smaller volume discharges associated with plant auxiliary systems would be discharged in accordance with the applicable VPDES water quality standards. Therefore, potential impacts from constituents in the cooling tower blowdown water and plant auxiliary systems' discharges from the new units would be small.

ER Section 5.5.1.3, Impacts of Discharges to Air. The section is revised to note the small effect of cooling towers on the air quality around the plant site. ER Section 5.5.1.3 will be revised to read as follows:

Operation of the new units would increase small amounts of gaseous emissions to the air, primarily from equipment associated with plant auxiliary systems (e.g., diesel engines). Dry and wet cooling tower impacts on terrestrial ecosystems are addressed in Section 5.3.3.2. Potential impacts associated with Unit 3 wet cooling towers and Units 3 and 4 dry cooling towers would be small and restricted within the NAPS site boundary. Other minor air emission sources associated with the new units would be operated in accordance with federal, Virginia, and local air quality control laws and regulations. Impacts to air would be small.

ER Section 5.7.1, Light-Water-Cooled Reactors. This Section is revised to incorporate the revised thermal and electrical outputs for ESBWR The 5th paragraph of ER Section 5.7.1 will be revised to read as follows:

The LWR technologies being considered to demonstrate site suitability include the ABWR, the ESBWR, the AP-1000 (Advanced Passive PWR), the IRIS, and the ACR-700 (Advanced light-water-cooled version of the CANDU Reactor). The standard configuration for each of these reactor technologies is as follows. The ABWR is a single-unit, 4300 MWt, nominal 1500 MWe reactor. The ESBWR is a similar BWR: single-unit, 4500MWt, nominal 1520 MWe. The AP-1000 is a single-unit, 3400 MWt, nominal 1117–1150 MWe PWR. The IRIS is a three-module PWR configuration for a total of 3000 MWt and nominal 1005 MWe. The ACR-700 is a twin-unit, 3964 MWt, nominal 1462 MWe, light-water-cooled CANDU reactor.

ER Section 5.8.1.2, Noise. This section is revised discuss noise level from the wet and dry cooling towers Paragraphs 1-4 of ER Section 5.8.1.2 will be revised to read as follows:

The new units would produce noise from the operation of pumps, wet and dry cooling tower fans, water cascading down the wet cooling towers, transformers, turbines, generators, and switchyard equipment. The noise levels would be controlled in accordance with applicable local county regulations. As described in Section 5.3.4, Virginia has no state regulations or guidelines regarding noise limits. The nearby counties (Louisa and Spotsylvania) maintain county ordinances to prohibit unnecessary, unreasonable, or disturbing noise (Reference 1) (Reference 2).

Most equipment would be located inside structures reducing the outdoor noise level. Noise would be further attenuated by distance to the NAPS site boundary. Wet and dry cooing towers would be located outdoors and would generate more significant noise levels.

Closed-cycle, combination dry and wet cooling towers would be used for heat dissipation for Unit 3. Wet cooling towers would remove the heat by spraying the water into a forced air stream. Motor driven fans would be used to force air flow. The noise level from the wet cooling towers would be most dominant and would be greater than the near-field noise from fans for the dry towers for Unit 3 and Unit 4. The sound level at the nearest point on the EAB, at approximately 300 feet to the west of proposed cooling tower location, would be less than 60 to 65 dBA,. This is lower than the than NRC–defined significant levels at the EAB (See Section 5.3.4). The nearest residence is about 3000 feet to the north of the planned cooling tower location (see Figure 5.8-1). Noise levels below 60 to 65 dBA are considered to be of small significance (Reference 3). Therefore, the noise impact at the nearest residence would be small and no mitigation would be warranted.

Dry towers would be used for heat dissipation for the new Unit 3 and Unit 4. In order to dissipate enough heat and to minimize the generation of local air turbulence, fans used for dry towers are large and slow. As noted above, noise from the Unit 3 wet cooling towers would be most dominant. However, during operation of dry towers only, the low speed fans could produce low frequency noise that could travel relatively long distances under certain meteorological conditions. Noise impacts could be significant if dry towers are located near residential areas. Although noise would not cause adverse offsite impacts, a noise study would be performed as part of the final selection of the Unit 3 and Unit 4 cooling system and the results described in the COL application.

ER Section 5.8.1.4, Thermal Emissions. This section is revised to indicate that any increase in overall atmosphere temperature due to the dry and wet cooling towers would be much localized to the NAPS site. ER Section 5.8.1.4 will be revised to read as follows:

Heat dissipation to the atmosphere from operation of the Unit 3 dry and wet cooling towers and Unit 4 dry towers is described in Section 5.3.3.1. Because any increase in overall atmosphere temperature would be very localized to the NAPS site, and there is no residential area within the NAPS site boundary, there would be no heat impacts on nearby communities.

ER Section 5.8.1.5, Visual Intrusions. This section is revised to indicate that small visual impacts would result due to Unit 3 wet and dry cooling towers and Unit 4 dry cooling towers. The 2nd paragraph of ER Section 5.8.1.5 will be revised to read as follows:

The existing units' Turbine Building is about 100 feet above grade and the existing units' containment buildings are about 130 feet above grade. Because the new units' turbine building could be approximately 230 feet above grade and the Unit 3 wet and dry towers would be less than 80 feet tall and Unit 4 dry towers would be about 150 feet tall, small visual impacts would result.

ER Section 5.8.1.6, Other Related Impacts. This section is revised to identify that Unit 3 would use closed-cycle, combination dry and wet cooling towers with North Anna Reservoir as the make-up water supply and that the wet cooling tower blowdown would be discharged to the WHTF. The 1st paragraph of ER Section 5.8.1.6 will be revised to read as follows:

Water withdrawal and the associated discharge of heated water from the new Unit 3 would be conducted in accordance with federal, state and local regulations that govern water quality. As described in Section 3.4.1, new Unit 3 would use closed-cycle, combination dry and wet cooling towers with the North Anna Reservoir as the make-up water supply and the wet cooling tower blowdown would be discharged to the WHTF. The new Unit 4 would use a dry tower system for heat dissipation.

ER Table 5.10-1, Summary of Impacts and Measures and Controls to Limit Adverse Impacts During Operations. Table 5.10-1 is revised to summarize the impact description and Feasible and Adequate Measures/Controls based on changes to Unit 3 cooling system and the preceding sections. ER Table 5.10-1 will be revised to read as follows:

[See following pages]

Table 5.10-1 Summary of Impacts and Measures and Controls to Limit Adverse Impacts During Operations

Section Reference	Potential Impact Significance [a, b]														Feasible and Adequate Measures/Controls
	Noise	Erosion and Sediment	Air Quality	Traffic	Wastes	Surface Water	Groundwater	Land-Use	Water-Use	Terrestrial	Aquatic Ecosystems	Socioeconomic	Radiation Exposure	Other (site-specific)	Impact Description or Activity
5.1 Land-Use Impacts															
5.1.1 The Site and Vicinity			S	S											• The NAPS site is zoned by Louisa County as "industrial." This designation would not change due to operation of the new units. • The change in temperature at the discharge point of WHTF due to operation of new units would be negligible and would not impact recreational use. • The impact of Heat and moisture dissipation from new wet and dry cooling towers on overall atmospheric temperature is limited to NAPS site boundary. • Increased traffic loads on existing network from workforce during	• Comply with VPDES permit requirements imposed on water discharges from operation of the new units. • No new public roads needed for operation of the new units. Potential increases in traffic would be mitigated through effective traffic management.

a. The assigned significance levels [(S)mall, (M)oderate, or (L)arge are based on the assumption that for each impact, the associated proposed mitigation measures and controls (or equivalents) would be implemented.

b. A blank in the elements column denotes "no impact" on that specific element due to the assessed impacts.

Section Reference	Potential Impact Significance [a, b]															Feasible and Adequate Measures/Controls
	Noise	Erosion and Sediment	Air Quality	Traffic	Wastes	Surface Water	Groundwater	Land-Use	Water-Use	Terrestrial	Aquatic Ecosystems	Socioeconomic	Radiation Exposure	Other (site-specific)	Impact Description or Activity	
															operations	
5.1.2 Transmission Corridors and Offsite Areas															• The existing transmission lines and corridors have sufficient capacity for the total output of the existing and new units.	None
5.1.3 Historic Properties														S	• No impacts identified beyond those associated with construction of the proposed new units.	None
5.2 Water-Related Impacts																

Section Reference	Potential Impact Significance [a, b]														Feasible and Adequate Measures/Controls
	Noise	Erosion and Sediment	Air Quality	Traffic	Wastes	Surface Water	Groundwater	Land-Use	Water-Use	Terrestrial	Aquatic Ecosystems	Socioeconomic	Radiation Exposure	Other (site-specific)	Impact Description or Activity
5.2.1 Hydrologic Alterations and Plant Water Supply									S						• Reduction in the volume of water available to be released from the North Anna Dam • Reductions in Lake Anna water levels from current values during periods of extended drought	• Practices to minimize the hydrologic alterations may be implemented. • During periods of extended drought, dry cooling towers would be put into service to dissipate a portion of waste heat from Unit 3 to minimize the make-up water requirements
5.2.2 Water-Use Impacts									S						• Reduction in the volume of water available to be released from the North Anna Dam • Reductions in Lake Anna water levels from current values during periods of extended drought • There would be no appreciable water quality impacts due to blowdown from the Unit 3 wet cooling towers. There would be no blowdown from the Unit 3 and Unit 4 dry cooling towers.	During periods of extended drought, dry cooling towers would be put into service to dissipate a portion of waste heat from Unit 3 to minimize the make-up water requirements.

Section Reference	Potential Impact Significance [a, b]														Feasible and Adequate Measures/Controls
	Noise	Erosion and Sediment	Air Quality	Traffic	Wastes	Surface Water	Groundwater	Land-Use	Water-Use	Terrestrial	Aquatic Ecosystems	Socioeconomic	Radiation Exposure	Other (site-specific)	Impact Description or Activity
5.3.1 Intake System															The make-up water intake system for Unit 3 would consist of a new intake structure and located in a cove on the south shore of Harris Creek to withdraw water from North Anna Reservoir. The area to be occupied by this intake system, originally planned for the intake of the previously abandoned Units 3 and 4, is adjacent to the cove that houses the intake of the existing units.
5.3.1.1 Hydrodynamic Descriptions and Physical Impacts															• Evaluation concludes that the potential for scouring of the lake bottom, erosion of the shoreline, increased turbidity, and increased siltation from operation of the new units would be small. — • Stabilizing the banks of the channel to the screen house and pump house would be considered.
5.3.1.2 Aquatic Ecosystems															• Increase in impingement of fish from new water intake system. Increases in impingement by important species would represent only a small percentage of the estimated standing crop in Lake Anna. Any increased impingement would be offset by natural compensation due to a stable, healthy, and diverse fish population. — • The intake structure for the new Unit 3 at the ESP site would meet Section 316(b) of the Clean Water Act and the implementing regulations, as applicable. • A fish return system based on the latest technology available during detailed engineering would be considered for incorporation into the intake system.

Section Reference	Potential Impact Significance [a,b]														Feasible and Adequate Measures/Controls
	Noise	Erosion and Sediment	Air Quality	Traffic	Wastes	Surface Water	Groundwater	Land-Use	Water-Use	Terrestrial	Aquatic Ecosystems	Socioeconomic	Radiation Exposure	Other (site-specific)	Impact Description or Activity
5.3.1.2 Aquatic Ecosystems (con't)															• Increase in entrainment of larval fish from new make-up water intake system would be very small. Mortality rates for eggs and larval fish of important species in Lake Anna due to natural causes are extremely high. In spite of this, the fishery in Lake Anna has remained stable, healthy, and productive. Any slight increases in mortality due to entrainment from the additional intake systems would have a negligible impact on the Lake Anna fishery.	None
5.3.2 Discharge System															Blowdown from Unit 3 wet cooling towers would be sent via the WHTF to the North Anna Reservoir for heat dissipation. The blowdown discharge volume from Unit 3 is very small when compared with the discharge volume from the existing Units. The increase in water temperature due to operation of new units would be negligible.	
5.3.2.1 Thermal Description and Physical Impacts															• The blowdown discharge volume from Unit 3 is very small when compared with the discharge volume from the existing Units. The increase in water temperature due to operation of new units would be negligible.	

Section Reference	Potential Impact Significance [a, b]															Feasible and Adequate Measures/Controls
	Noise	Erosion and Sediment	Air Quality	Traffic	Wastes	Surface Water	Groundwater	Land-Use	Water-Use	Terrestrial	Aquatic Ecosystems	Socioeconomic	Radiation Exposure	Other (site-specific)	Impact Description or Activity	
5.3.2.1 Thermal Description and Physical Impacts (con't)															• Assuming new Unit 3 on closed-cycle, combination dry and wet cooling tower system and new Unit 4 on a closed-cycle dry tower system, there are no expected impacts such as scouring of the lakebed or erosion of the shoreline at the current discharge point (i.e., Dike 3) from operation of the existing units in combination with the new units. No mitigation measures or control are proposed beyond overall cooling system design. • Evaluation concludes that the potential for scouring of the lake bottom, erosion of the shoreline, increased turbidity, and increased siltation from operation of the new units would be very small.	None
5.3.2.2 Aquatic Ecosystems															• Negligible impact from scouring and sediment transport due to increased water discharge flows.	• Maintain compliance with VPDES water quality standards and permitted discharge limits for cooling water discharges to the North Anna Reservoir.

Section Reference	Potential Impact Significance [a, b]															Feasible and Adequate Measures/Controls
	Noise	Erosion and Sediment	Air Quality	Traffic	Wastes	Surface Water	Groundwater	Land-Use	Water-Use	Terrestrial	Aquatic Ecosystems	Socioeconomic	Radiation Exposure	Other (site-specific)	Impact Description or Activity	
5.3.2.2 Aquatic Ecosystems (con't)															• The addition of new Unit 3 would cause no thermally-induced impact on the fish population in Lake Anna. Sudden changes in discharge temperature are typically minimal with a nuclear power facility since units do not come on and off-line regularly. This limits the potential for heat or cold shock to fish.	None
5.3.3 Heat-Discharge System															N/A	
5.3.3.1 Heat Dissipation to the Atmosphere															• Operation of Unit 3 wet cooling towers may produce visible plume, salt drift and steam fog. Salt deposition rates would be below threshold value beyond the site boundary at ground levels. • Most of the fogging from the wet cooling towers would occur within site boundary in winter and spring. No	Industry standard techniques would be implemented during the final design to limit fogging to be within reasonable levels.

Section Reference	Potential Impact Significance [a, b]														Feasible and Adequate Measures/Controls
	Noise	Erosion and Sediment	Air Quality	Traffic	Wastes	Surface Water	Groundwater	Land-Use	Water-Use	Terrestrial	Aquatic Ecosystems	Socioeconomic	Radiation Exposure	Other (site-specific)	Impact Description or Activity
															icing would be anticipated within or beyond the site boundary • There would be no plume associated with the Unit 3 and Unit 4 dry cooling towers, and consequently no potential interaction with other permitted air emission sources at the existing units (e.g., standby diesel generators and auxiliary power systems) at the site.	
5.3.3.2 Terrestrial Ecosystems	S													S	• Predicted noise from heat dissipation system would be similar to or less than NAPS site current operating levels. • Potential for avian collisions with dry and wet cooling towers would be small.	None None

Section Reference	Potential Impact Significance [a, b]														Feasible and Adequate Measures/Controls
	Noise	Erosion and Sediment	Air Quality	Traffic	Wastes	Surface Water	Groundwater	Land-Use	Water-Use	Terrestrial	Aquatic Ecosystems	Socioeconomic	Radiation Exposure	Other (site-specific)	Impact Description or Activity
5.3.4 Impacts to Members of the Public	S				S	S	S		S						• Thermal effluent discharge from Unit 3 wet cooling tower systems would not alter the temperature regime in Lake Anna. Assessed temperature increases due to addition of Units 3 and 4 would be insignificant and would not contribute to an environment conducive to the reproduction and growth of thermophilic micro-organisms in the WHTF or alter the recreational uses of Lake Anna. • The recently upgraded on-site sewage treatment plant at the NAPS site includes disinfection to reduce coliform bacteria and other micro-organism to levels that meet Virginia water quality standards.	None
															• Small potential for offsite noise impacts from wet and dry cooling tower system operation. Modeled peak noise levels from operation of the composite cooling system would be below threshold levels.	None
5.4 Radiological Impacts of Normal Operation																

Section Reference	Potential Impact Significance [a, b]															Feasible and Adequate Measures/Controls
	Noise	Erosion and Sediment	Air Quality	Traffic	Wastes	Surface Water	Groundwater	Land-Use	Water-Use	Terrestrial	Aquatic Ecosystems	Socioeconomic	Radiation Exposure	Other (site-specific)	Impact Description or Activity	
5.4.1 Exposure Pathways			S			S	S	S	S	S	S	S	S		• Potential for small discharges of radioactive liquids and gases to the environment. • Direct dose contribution from the new units would be negligible.	• Sources of radiation at the new units would be contained similar to the existing units.
5.4.2 Radiation Doses to Members of the Public													S		See Section 5.4.3 for discussion of impacts to members of the public.	
5.4.3 Impacts to Members of the Public													S		• Potential doses to the public from liquid radwaste effluent releases to the discharge canal and WHTF and gaseous pathway releases. Calculated doses to public through liquid and gaseous pathways are within the design objectives of 10 CFR 50 Appendix I and within regulatory limits of 40 CFR 190.	None
5.4.4 Impacts to Biota Other than Members of the Public													S		• Potential doses to biota from liquid and gaseous effluents. Although there are no acceptance criteria specifically for biota, there is no scientific evidence that chronic dose rates below 100 mrad/day are harmful to plants and animals. The biota doses are all less than 1 mrad/day.	None
5.5 Environmental Impact of Waste																

Section Reference	Potential Impact Significance [a, b]															Feasible and Adequate Measures/Controls
	Noise	Erosion and Sediment	Air Quality	Traffic	Wastes	Surface Water	Groundwater	Land-Use	Water-Use	Terrestrial	Aquatic Ecosystems	Socioeconomic	Radiation Exposure	Other (site-specific)	Impact Description or Activity	
5.5.1 Nonradioactive-Waste-System Impacts			S		S	S			S		S				• Increased volume of discharged effluent. • Increased chemicals and other pollutants in the discharge effluent. • Increased storm water discharge • Increase in total volume of solid waste generated. • Potential increase in gaseous emissions. • Increase in total volume of sanitary waste generated.	• Water availability issues regarding the North Anna River are addressed via regulated releases from the North Anna Dam. • Comply with applicable VPDES water quality standards for any discharge from Dike 3. • Prepare and implement a new operational Storm Water Pollution Prevention Plan to avoid and/or minimize releases of contaminated storm water. • Use approved transporters and offsite landfills for disposal of solid waste. Continue existing units' program for reuse and recycling of nonradwastes. • Operate any new minor air emission sources in accordance with applicable regulations and permits. • Modify (if necessary) existing sanitary waste treatment systems to accommodate increased volume.

Section Reference	Potential Impact Significance [a, b]														Feasible and Adequate Measures/Controls
	Noise	Erosion and Sediment	Air Quality	Traffic	Wastes	Surface Water	Groundwater	Land-Use	Water-Use	Terrestrial	Aquatic Ecosystems	Socioeconomic	Radiation Exposure	Other (site-specific)	Impact Description or Activity
5.5.2 Mixed Waste Impacts					S	S	S		S				S	S	• Expected annual generation of between 15–30 cubic feet of mixed liquid waste and 5–10 cubic feet of mixed solid waste. • Potential chemical hazardous and occupational exposure to radiological materials during handling and storage onsite. • Potential exposures to onsite workers and emergency response personnel during accidental releases and cleanup activities.	• Limit need to manage and dispose of mixed waste through: 1) source reduction; 2) recycling options; 3) treatment. • Develop a Waste Minimization Program, to address mixed waste inventory management; equipment maintenance; recycling and reuse; segregation; treatment (decay in storage); work planning; waste tracking; and awareness training. • Implement a program to manage wastes stored onsite in compliance with applicable EPA and NRC regulatory requirements. • Implement spill prevention and response plans and procedures to address hazards associated with managing mixed wastes. Include in plans and procedures measures for response personnel training and protective equipment.
5.6 Transmission System Impacts															

Section Reference	Potential Impact Significance [a, b]															Feasible and Adequate Measures/Controls
	Noise	Erosion and Sediment	Air Quality	Traffic	Wastes	Surface Water	Groundwater	Land-Use	Water-Use	Terrestrial	Aquatic Ecosystems	Socioeconomic	Radiation Exposure	Other (site-specific)	Impact Description or Activity	
5.6.1 Terrestrial Ecosystems	S		S							S					• Air emissions and nuisance noise from use of helicopter to maintain transmission corridors. Virginia Power's current maintenance activities for the transmission corridors are infrequent and limited to the localized areas of the corridor. No new maintenance practices are expected for the new units.	None
5.6.2 Aquatic Ecosystems											S				• Potential impacts to mussel species from maintenance of transmission corridors. Although some mussel species occur in Louisa County, there are no confirmed accounts of mussels in watercourses crossed by existing transmission lines. There are no mitigation measures since there are no planned changes to transmission corridor maintenance practices for the proposed new units.	None
5.6.3 Impacts to Members of the Public	S													S	• Based on an initial evaluation, the existing transmission lines and corridors have sufficient capacity for the total output of the existing and new units. Mitigation of potential impacts from electric shock, EMF exposure, noise, or visual impacts would be unchanged.	None

Section Reference		Potential Impact Significance [a, b]														Feasible and Adequate Measures/Controls
		Noise	Erosion and Sediment	Air Quality	Traffic	Wastes	Surface Water	Groundwater	Land-Use	Water-Use	Terrestrial	Aquatic Ecosystems	Socioeconomic	Radiation Exposure	Other (site-specific)	Impact Description or Activity
5.7	Uranium Fuel Cycle Impacts															
5.7	Uranium Fuel Cycle Impacts (i.e., relative to the reference LWR)			S			S							S		• Yellowcake production and uranium conversion impacts such as energy required, emissions, and water. • Air emissions from fossil fuel plants supplying the gaseous diffusion plant. • Production of UO_2 during fuel fabrication • Radioactive waste management from operations, and decontamination and decommissioning.	• Select mining techniques that minimize potential impacts. • Consider use of new technology that requires less uranium hexafluoride. • Consider use of centrifuge process over gaseous diffusion process, which can significantly reduce energy requirements and environmental impacts. • Consider use of new technologies with less fuel loading to reduce energy, emissions and water usage. Projected impacts of TRISO fuel plant would be less than existing air, water, and solid waste regulations. • Consider use of new gas-cooled reactor technologies that can result in generation of far less low-level wastes.
5.8	Socioeconomic Impacts															

Section Reference	Potential Impact Significance [a, b]															Feasible and Adequate Measures/Controls
	Noise	Erosion and Sediment	Air Quality	Traffic	Wastes	Surface Water	Groundwater	Land-Use	Water-Use	Terrestrial	Aquatic Ecosystems	Socioeconomic	Radiation Exposure	Other (site-specific)	Impact Description or Activity	
5.8.1 Physical Impacts of Station Operation	S		S	S				S						S	• Noise associated with dry and wet cooling towers would be below level considered nuisance to public at the nearest residence. • Potential impacts from air emissions associated with diesel generators and auxiliary power systems • Potential visual impacts to surrounding areas due to new buildings, and wet and dry cooling towers.	• Comply with applicable VDEQ permit limits and regulations when installing and operating air emission sources. • Perform noise study as part of final design for dry cooling towers. • Perform visual impact study for new structures on site, including dry and wet cooling towers, as part of final design.
															• Local roads would experience increased operations traffic but have sufficient capacity without implementation of additional mitigation measures or controls.	None

Section Reference	Potential Impact Significance [a, b]														Feasible and Adequate Measures/Controls
	Noise	Erosion and Sediment	Air Quality	Traffic	Wastes	Surface Water	Groundwater	Land-Use	Water-Use	Terrestrial	Aquatic Ecosystems	Socioeconomic	Radiation Exposure	Other (site-specific)	Impact Description or Activity
5.8.2 Social and Economic Impacts of Station Operation												S		S	• Increase need for community services up to 2900 persons. Overall impact to services in the surrounding counties would be small. Predicted workforce is a small fraction of the total projected population growth in the region. • Revenue from sales and use taxes would be beneficial to Louisa County. • Property taxes paid by new workers in the region would be beneficial but small relative to those already obtained from the regional population. • Potential aesthetic impacts (e.g., visual, noise) to residences and recreational users of Lake Anna	• Perform noise study as part of final design for dry and wet cooling towers. • Perform visual impact study for new structures on site, including dry and wet cooling towers, as part of final design.
5.8.3 Environmental Justice Impacts															• No disproportionatly high impacts on minority or low-income populations resulting from operation of the proposed new units.	None
5.9 Decommissioning																

Section Reference	Potential Impact Significance [a, b]														Feasible and Adequate Measures/Controls
	Noise	Erosion and Sediment	Air Quality	Traffic	Wastes	Surface Water	Groundwater	Land-Use	Water-Use	Terrestrial	Aquatic Ecosystems	Socioeconomic	Radiation Exposure	Other (site-specific)	Impact Description or Activity
5.9 Decommissioning															• Potential radiation exposure related to decommissioning, including transportation of materials to disposal sites. • Decommissioning methods are expected to produce impacts equivalent to operations.	• The significance of the impacts is unknown because the decommissioning methods have not been chosen. No mitigation measures or controls are proposed at this time.

ER Section 6.1.2, Pre-Application, Pre-Operational, and Operational Thermal Monitoring. This section is revised to reflect the need for continuing the plant thermal monitoring program. ER Section 6.1.2 will be revised to read as follows:

The current thermal monitoring plan has provided sufficient thermal data to establish baseline conditions prior to any construction. This program would be continued for pre-operational monitoring of the new units (while under construction) to establish a baseline for identifying and assessing the environmental impacts resulting from operation of the new units. The same program would continue to be used for operational monitoring of the new and existing units.

ER Section 6.3.2, Construction and Pre-Operational Monitoring. This section is revised to reflect the change to a make-up water intake structure. The 2nd paragraph of ER Section 6.3.2 will be revised to read as follows:

Also, prior to construction of the new units, an approved Erosion and Sediment Control Plan would be developed and implemented in accordance with state and local regulations (Reference 2). The Erosion and Sediment Control Plan would require periodic visual inspection of erosion and sediment control best management practices that have been implemented. If erosion or sediment deposition is discovered outside the defined limits of disturbance, measures would be implemented to correct the problem. Additionally, any hydrological monitoring required in conjunction with permits associated with construction of the make-up water intake structure or removal of the existing coffer dam at the intake location would be implemented via a specific construction monitoring plan, if necessary.

ER Section 6.5.2.2, Construction and Pre-Operational Monitoring. This section is revised to note the change to a cooling tower make-up structure. The 1st paragraph of ER Section 6.5.2.2 will be revised to read as follows:

Construction of the new units would result in minor temporary disruptions of some aquatic habitats. The addition of a new Lake Anna intake structure for Unit 3 wet cooling tower make-up, and removal of the existing intake cofferdam would contribute to temporary increases in the turbidity of the water in these disturbed areas. The land clearing and earthwork associated with construction of the new units could similarly result in temporary increases in the turbidity in adjacent surface water bodies. As appropriate, soil erosion and sedimentation controls and construction-phase storm water management practices would be employed to minimize the sediment-related impacts to these surface water resources. Therefore, new unit construction would not reduce the local or regional diversity of aquatic species.

ER Section 6.5.2.3, Operational Monitoring. This section is updated to describe the effect of water withdrawal and discharge rate to Lake Anna Reservoir from the Combination Wet and Dry Cooling Tower system of the new units on the fish of the reservoir. ER Section 6.5.2.3 will be revised to read as follows:

While the addition of the new units would increase water withdrawal rates (to provide make-up water for the cooling towers), and, very slightly, the water discharge rates (due to cooling tower blowdown), operation with the new units would be fundamentally similar to the operation with the existing units. The impact of these changes on lake temperature would be negligible. Therefore, operation of the new units is not predicted to have any impact or to cause habitat reductions for striped bass. Likewise, other aquatic species are predicted to not be affected. Consequently, the operational-phase aquatic ecological monitoring program for the new units would be an extension of the ongoing Virginia Power and VDGIF monitoring programs.

ER Section 7.1.3, Source Terms. This section is revised to scale up the ABWR source terms to the proposed ESBWR core thermal power of 4500 MWt. The 1st and 2nd paragraphs of ER Section 7.1.3 will be revised to read as follows:

Doses are calculated based on the time-dependent activities released to the environment during each DBA. The activities are based on the analyses used to support the reactor standard safety analysis reports. Different reactor technologies use different source terms and approaches in defining the activity releases. The ABWR source term is based on TID-14844 (Reference 9). Environmental releases are calculated using the guidance in the NUREG-0800 and RGs 1.3 and 1.25 (Reference 10 and Reference 11, respectively). The AP1000 source terms, methodologies, and assumptions are based on the alternative source term methods outlined in RG 1.183. The activity releases and doses for the AP1000 and the ABWR are based on 102 percent of core thermal power. Assuming the ESBWR to be similar to the ABWR, the ABWR activity releases are scaled up from a power level of 4005 MWt (102 percent of 3926 MWt, as specified in the design certification) to 4590 MWt (102 percent of 4500 MWt, the power proposed for a new ESBWR unit at the ESP site), an adjustment factor of 1.15.

The IRIS and ACR-700 source term information is preliminary, but the AP1000 LOCA is expected to bound the worst-case accident releases for these advanced reactor concepts. The advanced gas reactor designs (GT-MHR and PBMR) use mechanistic accident source terms and postulate relatively small environmental releases, compared with the water reactor technologies. The activity releases to the environment are typically provided by the reactor vendors as part of their standard design packages.

ER Section 7.1.4, Radiological Consequences. This section is revised to scale up the ABWR doses to the proposed ESBWR core thermal power of 4500 MWt. The 2nd paragraph of ER Section 7.1.4 will be revised to read as follows:

Details about the methodology and assumptions pertaining to each of the accidents, such as activity release paths and the credited mitigation features, may be found in the design certification documents for the AP1000 (Reference 12) and the ABWR (Reference 13). As the ABWR design certification document presents whole body and thyroid doses, an equivalent TEDE value is estimated by multiplying the thyroid dose by 0.03 and adding the product to the whole body dose in accordance with RG 1.183. Also, consistent with the activity releases in Section 7.1.3, the ABWR doses are scaled up by a factor of 1.15 from a power level of 4005 MWt (102 percent of 3926 MWt, as specified in the design certification) to 4590 MWt (102 percent of 4500 MWt, the power proposed for a new ESBWR unit at the ESP site). A summary of the resulting accident doses is presented in Table 7.1-2. This table also compares the environmental doses to the recommended limits in RG 1.183 and NUREG-0800 and shows that the evaluated dose consequences are within the recommended limits.

ER Table 7.1-2, Summary of Design Basis Accident Doses. To reflect scaling up to the ESBWR core thermal power of 4500 MWt, the ABWR doses for SRP Sections 15.6.2, 15.6.4, 15.6.5, and 15.7.4 of ER Table 7.1-2 will be revised to read as follows:

Table 7.1-2 Summary of Design Basis Accident Doses

SRP Section	Accident	Reactor	TEDE (Rem) EAB	LPZ	Limit
15.1.5	PWR Main Steam Line Break				
	Pre-Existing Iodine Spike	AP1000	3.9E-02	1.1E-02	25
	Accident-Initiated Iodine Spike	AP1000	4.5E-02	4.5E-02	2.5
15.2.8	PWR Feedwater System Pipe Break	AP1000	4.5E-02	4.5E-02	2.5
15.3.3	Reactor Coolant Pump Rotor Seizure (Locked Rotor Accident)	AP1000	1.4E-01	9.6E-03	2.5
		ABWR	Not Postulated		
15.3.4	Reactor Coolant Pump Shaft Break	AP1000	1.4E-01	9.6E-03	2.5
		ABWR	Not Postulated		
15.4.8	PWR Rod Ejection Accident	AP1000	1.7E-01	3.1E-02	6.3
15.4.9	BWR Control Rod Drop Accident	ABWR	Not Postulated		6.3
15.6.2	Failure of Small Lines Carrying Primary Coolant Outside Containment	AP1000	7.2E-02	4.8E-03	2.5
		ABWR	6.7E-03	4.3E-04	2.5
15.6.3	PWR Steam Generator Tube Rupture				
	Pre-Existing Iodine Spike	AP1000	1.7E-01	5.7E-03	25
	Accident-Initiated Iodine Spike	AP1000	8.4E-02	4.5E-03	2.5
15.6.4	BWR Main Steam Line Break				
	Pre-Existing Iodine Spike	ABWR	7.9E-02	5.1E-03	25
	Accident-Initiated Iodine Spike	ABWR	3.9E-03	2.5E-04	2.5
15.6.5	Loss-of-Coolant Accident	AP1000	1.4E+00	2.0E-01	25
		ABWR	2.7E-01	1.7E+00	25

SRP Section	Accident	Reactor	TEDE (Rem) EAB	LPZ	Limit
15.7.4	Fuel Handling Accident	AP1000	1.3E-01	9.6E-03	6.3
		ABWR	9.6E-02	6.3E-03	6.3

Notes:

The AP1000 design certification indicates that the doses associated with the feedwater system pipe break are bounded by the main steam line break (Reference 12, Section 15.2.8.3).

The AP1000 design certification indicates that the doses for the reactor coolant pump shaft break are bounded by the reactor coolant pump rotor seizure (Reference 12, Section 15.3.4.2).

The ABWR design certification indicates that there are no radiological consequences for the reactor coolant pump rotor seizure, the reactor coolant pump shaft break, and the control rod drop accident (Reference 13, Sections 15.3.3.5, 15.3.4.5, and 15.4.10.6).

ER Table 7.1-12, Activity Releases for ABWR Failure of Small Lines Carrying Primary Coolant Outside Containment. To reflect scaling up to the ESBWR core thermal power of 4500 MWt, ER Table 7.1-12 will be revised to read as follows:

Table 7.1-12 Activity Releases for ABWR Failure of Small Lines Carrying Primary Coolant Outside Containment

	Activity Release (Ci)		
Isotope	**0–2 hr**	**2–8 hr**	**Total**
I-131	2.11E+00	2.26E+00	4.36E+00
I-132	1.84E+01	1.84E+01	3.68E+01
I-133	1.42E+01	1.50E+01	2.92E+01
I-134	3.07E+01	2.81E+01	5.88E+01
I-135	2.04E+01	2.11E+01	4.15E+01
Total	8.59E+01	8.48E+01	1.71E+02

ER Table 7.1-13, Doses for ABWR Failure of Small Lines Carrying Primary Coolant Outside Containment. To reflect scaling up to the ESBWR core thermal power of 4500 MWt, the EAB and LPZ columns and Note of ER Table 7.1-13 will be revised to read as follows:

Table 7.1-13 Doses for ABWR Failure of Small Lines Carrying Primary Coolant Outside Containment

	ABWR EAB Dose (Sv)			χ/Q Ratio	Site TEDE (Rem)	
Time	W. Body	Thyroid	TEDE	(Site/ABWR)	EAB	LPZ
0–2 hr	9.40E-04	4.80E-02	2.38E-03	2.44E-02	6.65E-03	
0–8 hr	9.40E-04	4.80E-02	2.38E-03	1.58E-03		4.32E-04
8–24 hr						0.00E+00
24–96 hr						0.00E+00
96–720 hr						0.00E+00
Total	9.40E-04	4.80E-02	2.38E-03		6.65E-03	4.32E-04
Limit					2.5	2.5

Note: The ABWR TEDE is whole body dose plus 3% of thyroid dose. Since the ABWR design certification document does not include an LPZ dose for this accident, the site LPZ dose is obtained by multiplying the ABWR EAB dose by ratio of site LPZ χ/Q to ABWR EAB χ/Q. The site doses include a multiplier of 1.15 for power adjustment.

ER Table 7.1-18, Activity Releases for ABWR Main Steam Line Break. To reflect scaling up to the ESBWR core thermal power of 4500 MWt, ER Table 7.1-18 will be revised to reads as follows:

Table 7.1-18 Activity Releases for ABWR Main Steam Line Break

	Activity Release (Ci)	
Isotope	Pre-Existing	Accident Initiated
I-131	4.52E+01	2.26E+00
I-132	4.39E+02	2.20E+01
I-133	3.09E+02	1.55E+01
I-134	8.63E+02	4.33E+01
I-135	4.52E+02	2.26E+01
Kr-83m	7.55E-02	1.26E-02
Kr-85m	1.33E-01	2.22E-02
Kr-85	4.21E-04	6.99E-05
Kr-87	4.55E-01	7.55E-02
Kr-88	4.58E-01	7.61E-02
Kr-89	1.83E+00	3.06E-01
Kr-90	4.80E-01	7.89E-02
Xe-131m	3.28E-04	5.45E-05
Xe-133m	6.31E-03	1.05E-03
Xe-133	1.76E-01	2.93E-02
Xe-135m	5.38E-01	8.94E-02
Xe-135	5.01E-01	8.36E-02
Xe-137	2.29E+00	3.81E-01
Xe-138	1.75E+00	2.92E-01
Xe-139	8.02E-01	1.34E-01
Total	2.12E+03	1.07E+02

ER Table 7.1-19, Doses for ABWR Main Steam Line Break, Pre-Existing Iodine Spike. To reflect scaling up to the ESBWR core thermal power of 4500 MWt, the EAB and LPZ columns and Note of ER Table 7.1-19 will be revised to read as follows:

Table 7.1-19 Doses for ABWR Main Steam Line Break, Pre-Existing Iodine Spike

	ABWR EAB Dose (Sv)			χ/Q Ratio	Site TEDE (Rem)	
Time	W. Body	Thyroid	TEDE	(Site/ABWR)	EAB	LPZ
0–2 hr	1.30E-02	5.10E-01	2.83E-02	2.44E-02	7.91E-02	
0–8 hr	1.30E-02	5.10E-01	2.83E-02	1.58E-03		5.14E-03
8–24 hr						0.00E+00
24–96 hr						0.00E+00
96–720 hr						0.00E+00
Total	1.30E-02	5.10E-01	2.83E-02		7.91E-02	5.14E-03
Limit					25	25

Note: The ABWR TEDE is whole body dose plus 3% of thyroid dose. Since the ABWR design certification document does not include an LPZ dose for this accident, the site LPZ dose is obtained by multiplying the ABWR EAB dose by the ratio of site LPZ χ/Q to ABWR EAB χ/Q. The site doses include a multiplier of 1.15 for power adjustment.

ER Table 7.1-20, Doses for ABWR Main Steam Line Break, Accident-Initiated Iodine Spike. To reflect scaling up to the ESBWR core thermal power of 4500 MWt, the EAB and LPZ columns and Note of ER Table 7.1-20 will be revised to read as follows:

Table 7.1-20 Doses for ABWR Main Steam Line Break, Accident-Initiated Iodine Spike

	ABWR EAB Dose (Sv)			χ/Q Ratio	Site TEDE (Rem)	
Time	W. Body	Thyroid	TEDE	(Site/ABWR)	EAB	LPZ
0–2 hr	6.20E-04	2.60E-02	1.40E-03	2.44E-02	3.91E-03	
0–8 hr	6.20E-04	2.60E-02	1.40E-03	1.58E-03		2.54E-04
8–24 hr						0.00E+00
24–96 hr						0.00E+00
96–720 hr						0.00E+00
Total	6.20E-04	2.60E-02	1.40E-03		3.91E-03	2.54E-04
Limit					2.5	2.5

Note: The ABWR TEDE is whole body dose plus 3% of thyroid dose. Since the ABWR design certification document does not include an LPZ dose for this accident, the site LPZ dose is obtained by multiplying the ABWR EAB dose by the ratio of site LPZ χ/Q to ABWR EAB χ/Q. The site doses include a multiplier of 1.15 for power adjustment.

ER Table 7.1-23, Activity Releases for ABWR Loss-of-Coolant Accident. To reflect scaling up to the ESBWR core thermal power of 4500 MWt, ER Table 7.1-23 will be revised to read as follows:

Table 7.1-23 Activity Releases for ABWR Loss-of-Coolant Accident

	Activity Release (Ci)					
Isotope	**0–2 hr**	**2–8 hr**	**8–24 hr**	**24–96 hr**	**96–720 hr**	**Total**
I-131	2.97E+02	1.31E+02	1.06E+03	9.97E+03	7.12E+04	8.26E+04
I-132	4.03E+02	3.80E+01	3.71E+01	0.00E+00	0.00E+00	4.78E+02
I-133	6.20E+02	2.31E+02	1.35E+03	3.81E+03	7.74E+02	6.78E+03
I-134	5.88E+02	1.22E+00	0.00E+00	0.00E+00	0.00E+00	5.89E+02
I-135	5.89E+02	1.52E+02	3.80E+02	1.92E+02	0.00E+00	1.31E+03
Kr-83m	3.74E+02	5.33E+02	1.73E+02	0.00E+00	0.00E+00	1.08E+03
Kr-85	4.68E+01	3.53E+02	2.51E+03	2.49E+04	3.28E+05	3.56E+05
Kr-85m	9.66E+02	3.32E+03	5.00E+03	8.05E+02	0.00E+00	1.01E+04
Kr-87	1.37E+03	1.12E+03	1.05E+02	0.00E+00	0.00E+00	2.59E+03
Kr-88	2.43E+03	5.74E+03	3.93E+03	3.40E+02	0.00E+00	1.24E+04
Kr-89	2.07E+02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.07E+02
Xe-131m	2.43E+01	1.73E+02	1.28E+03	1.09E+04	7.12E+04	8.36E+04
Xe-133	8.74E+03	6.12E+04	4.31E+05	3.18E+06	9.62E+06	1.33E+07
Xe-133m	3.44E+02	2.49E+03	1.58E+04	8.69E+04	8.32E+04	1.89E+05
Xe-135	1.06E+03	5.25E+03	1.74E+04	1.34E+04	0.00E+00	3.71E+04
Xe-135m	5.57E+02	9.28E-02	0.00E+00	0.00E+00	0.00E+00	5.57E+02
Xe-137	5.88E+02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	5.88E+02
Xe-138	2.29E+03	1.55E-01	0.00E+00	0.00E+00	0.00E+00	2.29E+03
Total	2.15E+04	8.07E+04	4.80E+05	3.33E+06	1.02E+07	1.41E+07

ER Table 7.1-24, Doses for ABWR Loss-of-Coolant Accident. To reflect scaling up to the ESBWR core thermal power of 4500 MWt, the EAB and LPZ columns and Note of ER Table 7.1-24 will be revised to read as follows:

Table 7.1-24 Doses for ABWR Loss-of-Coolant Accident

	ABWR EAB Dose (Sv)			ABWR LPZ Dose (Sv)			χ/Q Ratio (Site/ ABWR)	Site TEDE (Rem)	
Time	W. Body	Thyroid	TEDE	W. Body	Thyroid	TEDE		EAB	LPZ
0–2 hr	4.10E-02	1.90E+00	9.80E-02				2.44E-02	2.74E-01	
0–8 hr				1.00E-02	3.10E-01	1.93E-02	1.39E-02		3.08E-02
8–24 hr				8.00E-03	2.00E-01	1.40E-02	2.26E-02		3.62E-02
24–96 hr				1.10E-02	7.90E-01	3.47E-02	6.46E-02		2.57E-01
96–720 hr				9.00E-03	1.10E+00	4.20E-02	2.92E-01		1.41+00
Total	4.10E-02	1.90E+00	9.80E-02	3.80E-02	2.40E+00	1.10E-01		2.74E-01	1.73E+00
Limit								25	25

Note: The ABWR TEDE is whole body dose plus 3% of thyroid dose. The site doses include a multiplier of 1.15 for power adjustment.

ER Table 7.1-27, Activity Releases for ABWR Fuel Handling Accident. To reflect scaling up to the ESBWR core thermal power of 4500 MWt, ER Table 7.1-27 will be revised to read as follows:

Table 7.1-27 Activity Releases for ABWR Fuel Handling Accident

	Activity Release (Ci)
Isotope	**0–2 hr**
I-131	1.41E+02
I-132	1.74E+02
I-133	1.45E+02
I-134	7.06E-06
I-135	2.36E+01
Kr-83m	7.37E+00
Kr-85m	9.78E+01
Kr-85	5.48E+02
Kr-87	1.41E-02
Kr-88	2.78E+01
Kr-89	9.32E-11
Xe-131m	9.56E+01
Xe-133m	1.26E+03
Xe-133	3.22E+04
Xe-135m	2.53E+02
Xe-135	7.30E+03
Xe-137	2.37E-10
Xe-138	4.92E-10
Total	4.23E+04

ER Table 7.1-28, Doses for ABWR Fuel Handling Accident. To reflect scaling up to the ESBWR core thermal power of 4500 MWt, the EAB and LPZ columns and Note of ER Table 7.1-28 will be revised to read as follows:

Table 7.1-28 Doses for ABWR Fuel Handling Accident

	ABWR EAB Dose (Sv)			χ/Q Ratio	Site TEDE (Rem)	
Time	W. Body	Thyroid	TEDE	(Site/ABWR)	EAB	LPZ
0–2 hr	1.20E-02	7.50E-01	3.45E-02	2.44E-02	9.64E-02	
0–8 hr	1.20E-02	7.50E-01	3.45E-02	1.58E-03		6.26E-03
8–24 hr						0.00E+00
24–96 hr						0.00E+00
96–720 hr						0.00E+00
Total	1.20E-02	7.50E-01	3.45E-02		9.64E-02	6.26E-03
Limit					6.3	6.3

Note: The ABWR TEDE is whole body dose plus 3% of thyroid dose. The site LPZ dose is obtained by multiplying ABWR EAB dose by ratio of site LPZ χ/Q to ABWR EAB χ/Q. The site doses include a multiplier of 1.15 for power adjustment.

ER Section 9.4.1, Heat Dissipation Systems. This section is revised to identify that the proposed base system for Unit 3 is a closed-cycle, combination dry and wet tower cooling system. This section is further revised to include once-through system as one of the alternatives which were compared and evaluated along with the base system. ER Section 9.4.1 will be revised to read as follows:

This evaluation focuses on identifying alternative heat dissipation systems that are feasible, legislatively compliant, and environmentally preferable. In accordance with NUREG-1555, this evaluation first compares these alternatives with the proposed system using standardized criteria that include land use, water use, thermal and physical impacts, atmospheric effects, noise generation, aesthetics and recreational benefits, generating efficiency, and operating and maintenance experience with similar units. (Reference 1, Section 9.4.1)

The proposed system and alternatives that prove to be feasible, legislatively compliant, and environmentally preferable have been economically evaluated. This economic evaluation is limited to a comparison of the relative costs of these screened alternatives.

Heat from the new units would be dissipated by two independent systems: a closed-cycle, dry and wet tower cooling system for Unit 3 and a closed-cycle dry tower system for Unit 4. The "base case" for Unit 3 is a closed-cycle, with a combination of dry and wet mechanical draft towers. The dry cooling tower would consist of a series of moderate profile rectangular structures that house large fans and piping and the wet cooling towers would consist of a series of multi-cell, rectangular cooling tower banks; associated intake/discharge, pumping, and piping systems would be required. Cooled water from the towers would be pumped first through the condenser, where it is heated. The heated water is then circulated through the dry and wet towers where it rejects heat to ambient air. Make-up water would be obtained from the North Anna Reservoir, and wet cooling tower blowdown would be discharged to the head of the existing discharge canal. The Unit 3 base case system is compared with the following heat dissipation alternatives:

- Once-through system (Alternative 1): This alternative would include a once-through system with its intake and pumping system on the North Anna Reservoir, and discharges to the head of the discharge canal.
- Once-through system with helper tower (Alternative 2): This alternative would include the once-through system and a small multi-cell mechanical draft cooling tower system. The helper tower would operate on an as-needed basis during the warmest summer months to mitigate the peak temperatures in the WHTF and the North Anna Reservoir by transferring heat to the environment via evaporation,

and directly to the atmosphere. Water would be withdrawn from the North Anna Reservoir and cooling tower blowdown would be returned to the discharge canal.

- Natural draft cooling tower system (Alternative 3): This alternative would consist of a number of free-standing, hyperbolic towers and associated intake/discharge, pumping, and piping systems. This closed-cooling system would withdraw water from the North Anna Reservoir and transfer heat to the environment via evaporation and directly to the atmosphere. Minor cooling tower blowdown discharges would be released to the existing discharge canal.
- Mechanical draft cooling tower system (Alternative 4): This alternative would consist of four multi-cell, rectangular cooling tower banks and associated intake/discharge, pumping, and piping systems. This closed-cooling system would withdraw water from the North Anna Reservoir and transfer heat to the environment via evaporation and directly to the atmosphere. Minor cooling tower blowdown discharges would be released to the existing discharge canal.
- Spray ponds (Alternative 5): This alternative would involve the addition of new surface water bodies on site and the addition of an extensive matrix of spray modules to promote evaporative cooling in the new ponds. Additional pumping and piping systems would be required.
- Dry tower system (Alternative 6): This alternative would consist of a series of moderate profile (150-foot high) rectangular structures that house large fans and piping. There would be little other resources required (e.g., water, wastewater) besides land.

The Unit 4 base case would consist of a dry tower system. The Unit 4 base case system is compared with the following heat dissipation alternatives:

- Once-through system (Alternative 7)
- Once-through system with helper tower (Alternative 8)
- Natural draft cooling tower system (Alternative 9)
- Mechanical draft cooling tower system (Alternative 10)
- Spray ponds (Alternative 11)

ER Section 9.4.1.1, Technical, Regulatory, and Environmental Review of Heat Dissipation Systems – Unit 3. This section is revised to indicate that in addition to the spray pond system, the once-through system and the once-through system with helper tower also posed regulatory barriers and therefore were removed from further consideration. The referenced tables in this section, 9.4.1, 9.4.2, and 9.4.3, containing factors affecting system selection were also revised to evaluate and compare the base system and the alternatives. ER Section 9.4.1.1 will be revised to read as follows:

The Unit 3 base case and alternative heat dissipation systems are evaluated and compared in Table 9.4-1 through Table 9.4-3.

The Unit 3 evaluation concludes that the following heat dissipation systems are feasible, legislatively compliant, and environmentally preferable or equivalent to the base case:

- Natural draft cooling tower system (Alternative 3)
- Mechanical draft cooling tower system (Alternative 4)
- Dry towers (Alternative 6)

The once-through system (Alternative 1), once-through system with helper tower (Alternative 2) and the spray pond system (Alternative 5) posed regulatory approval barriers, as presented in Table 9.4-2, and therefore have been removed from further consideration.

ER Section 9.4.1.1.1, Relative Economic Evaluation of Heat Dissipation Systems – Unit 3. This section is revised to discuss the capital costs and operating costs of the base case and the alternatives. ER Section 9.4.1.1.1 will be revised to read as follows:

The Unit 3 capital costs would be the highest for dry towers (Alternative 6). The capital cost for alternatives utilizing wet cooling towers (Alternatives 3 and 4) including the base case would be lower than dry towers. The operating costs of the wet cooling tower alternatives including the base case are lower than the dry towers (Alternative 6) primarily because of the higher equipment power demand from the dry tower fans.

ER Section 9.4.1.1.2, Alternative Heat Dissipation System Summary – Unit 3. This section is revised to indicate that not withstanding the advantages the once-through systems offer with respect to land use, aesthetics, operating experience, etc., they would not be acceptable for Unit 3 based on concerns expressed regarding the discharge water temperature to WHTF, resultant increase in lake water temperature, water usage from North Anna Reservoir and impacts on striped bass population. This section is further revised to discuss the operational flexibility offered by the combination dry and wet cooling tower system with regards to water usage and preserving lake water under drought conditions. ER Section 9.4.1.1.2 will be revised to read as follows:

Table 9.4-3 offers a summary comparison of the relative natural resource (i.e., land, water) requirements, environmental impacts, regulatory barriers, operating issues, and energy/economic considerations for the base case and the alternative heat dissipation systems for Unit 3. This table identifies the closed-cycle dry and wet tower system (base case) as the preferred cooling system option because of its advantages from a regulatory, water usage, and thermal impact perspective. The once-through cooling systems (Alternatives 1 and 2) offer advantages with respect to land use, aesthetics (no visual impact or noise), superior operating experience, and low impact on generating efficiency. However, the once-through systems raised concerns involving discharge water temperature to WHTF, resultant increase in lake water temperature, water usage from the North Anna Reservoir, potential impacts on striped bass population, and difficulty in obtaining regulatory approval. Therefore, the once through systems were determined to be unacceptable alternatives for Unit 3. While the remaining wet and dry tower systems (Alternatives 3, 4 and 6) scored less on key attributes than the base case, they did not present any fatal flaws, and thus, they were also deemed appropriate for further energy and economic review.

The subsequent cost comparisons show that the capital and operating costs of dry towers alone (Alternative 6) would be higher than the wet towers or combination dry and wet towers. The capital and operating costs of wet tower systems would be lower than the combination dry and wet tower system. However, the natural draft and mechanical draft cooling towers (Alternatives 3 and 4) would not provide the operational flexibility of the base case with regards to water usage and reduced downstream water flow. When water usage has to be reduced during drought conditions and low lake levels, the base case, which has the dry towers, would afford the ability to continue to operate Unit 3 with a minimum of 1/3 of the heat dissipation achieved through the use of the dry towers and depending on prevailing ambient conditions, a significantly higher than 1/3 of the heat dissipation could be achieved through the dry towers. Therefore, on the most important environmental factors essential for obtaining regulatory approval and preserving lake water under normal

and severe drought conditions, the combination wet and dry tower system is superior.

Thus, Table 9.4-3 illustrates that the Unit 3 base case is the preferable heat dissipation system.

ER Section 9.4.1.1.3, Thermal Impact and Water Level Enhancements – Unit 3. This section is revised to indicate that additional heat to Lake Anna from Unit 3 wet tower blowdown would be negligible, that water consumption with dry towers would be reduced, and that further mitigation options were not necessary. ER Section 9.4.1.1.3 will be revised to read as follows:

As demonstrated in previous sections, Lake Anna would dissipate the negligible waste heat from the continuous blowdown of Unit 3 wet towers. Because blowdown is taken from water already cooled in the towers, any additional waste heat to Lake Anna would be negligible. From a water level perspective, operation of dry towers during the maximum water conservation mode of operation would reduce water consumption from Lake Anna. Therefore, Dominion has not considered any other supplemental options to mitigate decreases in lake level from operation of the preferred Unit 3 combination dry and wet tower cooling system.

ER Section 9.4.1.2, Technical, Regulatory, and Environmental Review of Heat Dissipation Systems – Unit 4. This section is revised to indicate that all the alternatives evaluated will have to overcome significant regulatory barriers with respect to water usage from North Anna Reservoir. Tables 9.4-4 through 9.4-6 referenced in this section were revised to include minor changes. ER Section 9.4.1.2 will be revised to read as follows:

The Unit 4 base case and alternative heat dissipation systems are evaluated and compared in Table 9.4-4 through Table 9.4-6.

This tabular evaluation (Table 9.4-4 and Table 9.4-5) indicates that once through options (Alternative 7 and 8), wet cooling tower options (Alternatives 9 and 10), and the spray pond system (Alternative 11) would have to overcome significant regulatory barriers with respect to water usage from North Anna Reservoir. In particular, even with natural draft or mechanical cooling towers, a supplemental source of cooling water would be required during drought conditions to maintain minimum lake levels and downstream flows. The need for a supplemental source of cooling water would result in additional impacts, such as consumption of water from remote supplies and the impacts of transporting the water (e.g., the impacts of building a pipeline). In the absence of any identifiable and readily available source, none of these alternatives is currently deemed feasible.

ER Section 9.4.2, Circulating Water Systems. This section is revised to indicate that the proposed systems for Units 3 and 4 do not comprise an open loop circulating water system, and therefore, there is no need to evaluate circulating water system alternatives. This section is further revised to indicate that Unit 3 wet towers make-up water would be very small compared to the existing unit's intake. ER Section 9.4.2 will be revised to read as follows:

As presented in Section 9.4.1, the proposed heat dissipation systems for the new units at the ESP site are a closed-cycle, dry and wet cooling tower system for the first new unit (Unit 3), and a closed-cycle dry tower system for the second new unit (Unit 4). Since the proposed systems for Units 3 and 4 do not comprise an open loop circulating water system, there is no need to evaluate circulating water system alternatives. However, the closed loop circulating water system for Unit 3 would require continuous make-up water to the wet cooling tower basin to compensate for the evaporative losses and cooling tower blowdown when waste heat cannot be rejected via the dry towers alone. The quantity of make-up is only approximately 2% of what would be required to be withdrawn for a once-through system however. Therefore, the intake water for Unit 3 is very small compared to the existing units' intake. This evaluation focuses on identifying feasible make-up water intake systems that are legislatively compliant, environmentally preferable, and economically viable. In accordance with NUREG-1555 guidance, this evaluation first compares alternative intake water systems against the base case system using standardized criteria that include construction impacts, aquatic issues, water use, land use, and compliance with regulations (Reference 1, Section 9.4.2). As stated in NUREG-1555, the proposed system and alternatives that prove to be feasible, legislatively compliant, and environmentally preferable are then evaluated on an economic basis. In this case, a comparison of alternate intake water system components has not revealed alternatives that are preferable on an environmental basis. Therefore, further economic analysis of alternatives is not warranted.

.

The base case intake water system for Unit 3 is composed of the following components:

- Intake System: Shoreline
- Intake Location: Adjacent to existing intake structure on Lake Anna
- Discharge System: Shoreline
- Discharge Location: Existing discharge canal
- Water Supply: Lake Anna

- Water Treatment: Mechanical condenser cleaning and chemical biocide/corrosion/antiscalant treatment (cooling tower systems)

The following sections evaluate this base case against a list of potential alternative system components that address intake, discharge, water supply, and water treatment issues for Unit 3 only.

ER Section 9.4.2.2, Discharge System. This section is revised to indicate that the discharge water is even smaller than intake. Minor editorial changes made to Tables 9.4-9 and 9.4-10 referenced in this section. The 1st paragraph of ER Section 9.4.2.2 will be revised to read as follows:

While NUREG-1555 also suggests that the discharge system evaluation address alternative discharge systems, locations, and discharge port technology, the incomplete base case discharge design can only support consideration of alternate discharge systems and locations. The discharge water quantity is even smaller than the intake, since the discharge constitutes cooling tower blowdown only where as the intake comprises make-up for evaporative losses, drift losses, and blowdown. Table 9.4-9 and Table 9.4-10 provide comparisons of the following base and alternative discharge systems and locations.

ER Section 9.4.2.3, Water Supply. This section is revised to indicate that closed-cycle, dry and wet towers is the preferred system for Unit 3. ER Section 9.4.2.3 will be revised to read as follows:

The evaluation of alternative water supplies prescribed by NUREG-1555 is amended herein because of the certainty of water supply (Lake Anna) for the Unit 3 preferred closed-cycle, dry and wet cooling tower system and because of the application of the closed-cycle dry tower system for Unit 4.

ER Section 9.4.2.4, Water Treatment. This section is revised to evaluate water treatment options for the cooling tower base case. ER Section 9.4.2.4 will be revised to read as follows:

The evolving water treatment system design is not sufficiently mature to support all of the NUREG-1555 suggested water treatment evaluation processes: water treatment processes, chemical additives, and operating mode. Consequently, the evaluation of the water treatment processes focuses herein only on water treatment system issues for Unit 3. Table 9.4-11 provides a tabularized evaluation of the following base case and alternative water treatment systems.

- Water Treatment Systems
  - Mechanical Treatment (Base Case): Periodic mechanical cleaning of condenser tubing
  - Chemical Treatment (Alternative 7): Cooling water biofouling, corrosion and pH control chemical additives
  - Non-chemical Treatment (Alternative 8): Ultraviolet light sterilization

This evaluation demonstrates that the Unit 3 base case mechanical condenser cleaning option poses smaller adverse environmental impacts than the other technically-feasible alternative treatment system – the chemical treatment system. The mechanical cleaning system represents the environmentally-preferred treatment system for the Unit 3 condenser. However the mechanical cleaning process is not practical for the cooling towers. Therefore, chemical treatment (Alternative 7) will be necessary. A chemical treatment system would be selected which meets environmental impact limits. The dry tower system for Unit 4 poses minimal water treatment requirements. Further economic evaluation of the base case and alternative water treatment systems is unwarranted.

ER Section 9.4.2.5, Summary. This section summarizes the alternatives for the cooling tower base case. ER Section 9.4.2.5 will be revised to read as follows:

The evaluation of the key components (excluding water supply) of the base case and alternative intake water systems for Unit 3 indicates that the following base case configuration collectively represents the only environmentally preferable circulating water system:

- Intake System: Shoreline
- Intake Location: Adjacent to existing intake structure on Lake Anna
- Discharge System: Shoreline
- Discharge Location: Adjacent to existing discharge structure on discharge canal
- Water Supply: Lake Anna
- Water Treatment: Mechanical condenser cleaning and chemical biocide/corrosion/pH adjustment treatment as required for cooling towers

ER Table 9.4-1, Screening of Unit 3 Alternative Heat Dissipation Systems (Base Case & Alternatives 1–2). This table is revised to consider the Combination Dry and Wet Towers base case. ER Table 9.4-1 will be revised to read as follows:

[See following pages]

Table 9.4-1 Screening of Unit 3 Alternative Heat Dissipation Systems (Base Case & Alternatives 1–2)

Factors Affecting System Selection	Combination Dry and Wet Towers (Base Case)	Once-Through (Alternative 1)	Once-Through with Helper Tower (Alternative 2)
Land Use: Onsite Land Considerations	A combination dry and wet mechanical draft cooling tower (CDWMDCT) system would require more land (as compared to the OT system) to site widely spaced dry and wet towers. A CDWMDCT system could be placed within the confines of the existing NAPS site.	The once-through (OT) system would have the smallest land requirements. The OT system could be placed within the confines of the existing NAPS site.	A once-through and helper tower (OTHT) system would require marginally more land than is required by the OT system alone, but less than other cooling tower systems. The OTHT system could be placed within the confines of the existing NAPS site.
Land Use: Terrain Considerations	CDWMDCT system withdraws less water and so is less affected by significant terrain variations. Terrain features of the site are suitable for a CDWMDCT system.	OT systems require flat or gently rolling terrain to minimize pump head requirements. Terrain features of the site would not preclude the use of the OT system.	OTHT systems require flat or gently rolling terrain situations. Terrain features of the site are suitable for an OTHT system.

Factors Affecting System Selection	Combination Dry and Wet Towers (Base Case)	Once-Through (Alternative 1)	Once-Through with Helper Tower (Alternative 2)
Water Use	The closed wet cooling tower system would have considerable evaporative losses to the atmosphere, but these losses could be reduced by operation of the dry towers in the maximum water conservation mode, thus reducing the water usage and conserving water during drought conditions.	Per the PPE, the OT system would have an intake requirement of nearly 50 times more water than a mechanical draft wet cooling tower system (MDCT). OT -1,140,000 gpm Wet cooling systems – 23,950 gpm Despite this increased water intake requirement, the OT system would return most of the withdrawn water. However, the evaporative loss due to the increased temperature in the WHTF and the lake would exceed the consumption of the CDWMDCT (base case) in the Maximum Water Conservation mode.	An OTHT system would require the second largest water supply. Although the helper tower system would reduce water intake requirements, its use would not reduce water usage to below the combined dry and wet tower operation.
Regulatory Restrictions	An intake structure for a CDWMDCT system would meet Section 316(b) of the CWA and the implementing regulations, as applicable. The VPDES discharge permit thermal discharge limitation to the WHTF would need to be modified to account for the minor additional thermal load rejected by the new CDWMDCT system. These regulatory restrictions would have small impacts on this heat dissipation system.	The intake structure for the OT system would meet Section 316(b) of the CWA and the implementing regulations, as applicable. Because of concerns with thermal impacts and water consumption, permitting would be difficult.	An intake structure for the OTHT systems would meet Section 316(b) of the CWA and the implementing regulations, as applicable. While the helper tower would temper the thermal loading to the WHTF during the hottest summer season periods, concerns with thermal impacts and water consumption would pose an impediment to permitting.

Factors Affecting System Selection	Combination Dry and Wet Towers (Base Case)	Once-Through (Alternative 1)	Once-Through with Helper Tower (Alternative 2)
Atmospheric Effects	The CDWMDCT system would emit water droplets (drift) and intermittently produce a visible vapor plume. The drift droplets would be a minor source of particulate matter and salt deposition. The water vapor plume would result in minimal additional fogging but no icing conditions on local road systems. Aesthetic impacts from the visible plume would be small.	Since OT systems do not produce a visible plume and the associated pond-induced fogging (steam fog) is minimal, atmospheric effects would be small.	An OTHT system would emit water droplets (drift) and produce visible plumes during periods when the helper tower is in operation. The particulate, salt deposition and fogging and aesthetic impacts would not be significant from the infrequent/intermittent operation of this small cooling tower.
Thermal and Physical Effects	The CDWMDCT system would discharge a significantly smaller thermal load to the WHTF (compared to OT systems) because 65–85 percent of the heat removal in cooling towers is associated with evaporation (Reference 2). Most of the remaining heat is dissipated directly to the atmosphere. The small amount of heat from blowdown to the WHTF would be additive to the OT thermal load from the existing units. The VPDES permit thermal discharge criteria would need to be revised to reflect this minor addition.	The OT system would add thermal load to the WHTF, resulting in the greatest temperature increase to the WHTF and the lake. The VPDES permit thermal discharge criteria would need to be revised to reflect this addition of thermal load.	An OTHT system would add thermal load to the WHTF. The helper tower would temper the thermal loading to the WHTF during the hottest summer season periods, but the thermal impact would be greater than the base case. The VPDES permit thermal discharge criteria would need to be revised to reflect this addition of thermal load.

Factors Affecting System Selection	Combination Dry and Wet Towers (Base Case)	Once-Through (Alternative 1)	Once-Through with Helper Tower (Alternative 2)
Noise Levels	CDWMDCT operation would generate noise from fan and pump operation and from cascading water in the towers. The results of the Section 5.3.4 noise evaluation for combination dry and wet tower system suggests that noise impacts for the CDWMDCT will also be below the NRC-defined significance levels (60–65 dBA) at the EAB. Construction related noise impacts would be small.	OT system operation would generate small noise impacts from pump operation. Construction-related noise impacts would be small.	OTHT operation would generate noise from fan and pump operation and from cascading water in the towers during the periods when the helper tower is needed. The associated noise impacts would be less than the dry tower system impacts, which were below the NRC-defined significance levels (60–65 dBA) at the EAB as described in Section 5.3.4. Construction-related noise impacts would be small.
Aesthetics and Recreational Benefits	The CDWMDCT system would be wholly situated on the existing NAPS site and the primary external impact would be the minor discharge of heated water to the North Anna Reservoir via the WHTF. Discharges to the North Anna Reservoir, a popular recreational resource, would produce no tangible aesthetic or recreational benefits.	The OT system would be wholly situated on the existing NAPS site and its primary external impact would be the discharge of a large quantity of heated water to the North Anna Reservoir via the WHTF. Discharges to the North Anna Reservoir, a popular recreational resource, would produce no tangible aesthetic or recreational benefits.	An OTHT system would be wholly situated on the existing NAPS site and its primary external impact would be the discharge of large quantity of heated water to the North Anna Reservoir via the WHTF. Discharges to the North Anna Reservoir, a popular recreational resource, would produce no tangible aesthetic or recreational benefits.
Operating and Maintenance Experience	Dry and wet tower systems are common to power plants (both fossil and nuclear) and are considered highly reliable.	OT systems are common to older power plants (both fossil and nuclear) and they are considered highly reliable.	While OTHT systems are less common than OT systems, they do not pose any greater operating and maintenance risks than other cooling tower systems.

Factors Affecting System Selection	Combination Dry and Wet Towers (Base Case)	Once-Through (Alternative 1)	Once-Through with Helper Tower (Alternative 2)
Generating Efficiency Penalty	The energy penalty (% reduction in plant output) of CDWMDCT systems versus OT systems is 1.7 to 4 percent. (extrapolated from Reference 5, Tables 3-1 and 3.2).	The OT system has the least energy requirement. The energy penalty (% reduction in plant output) of wet tower systems versus OT systems is 1.7 to 1.9 percent. The energy penalty of dry tower systems versus OT systems is 8.5 to 11.4 percent. (Reference 5, Tables 3-1 and 3-2)	The additional energy requirements associated with cooling tower operation do not alter this system's energy efficiency advantages over wet cooling tower only systems.
Is this a suitable heat dissipation system?	Yes	No	No

ER Table 9.4-2, Screening of Unit 3 Alternative Heat Dissipation Systems (Alternatives 3–5). This table is revised to consider the Combination Dry and Wet Towers base case. ER Table 9.4-2 will be revised to read as follows:

[See following pages]

Table 9.4-2 Screening of Unit 3 Alternative Heat Dissipation Systems (Alternatives 3–6)

Factors Affecting System Selection	Natural Draft Cooling Towers (Alternative 3)	Mechanical Draft Cooling Towers (Alternative 4)	Spray Ponds (Alternative 5)
Land Use: Onsite Land Considerations	A natural draft cooling tower (NDCT) system would require less land (as compared to CDWMDCT system) to accommodate the hyperbolic towers. A NDCT system could be placed within the confines of the existing NAPS site.	A mechanical draft cooling tower (MDCT) system would require less land (as compared to the CDWMDCT system) to site the towers. An MDCT system could be placed within the confines of the existing NAPS site.	A spray pond-cooling alternative would involve the development of significant additional surface water impoundments and consequently pose the additional land requirements. It is unlikely that new spray ponds of sufficient size could be placed within the confines of the existing NAPS site.
Land Use: Terrain Considerations	NDCT systems withdraw less water and so are less affected by substantial terrain variations. Terrain features of the site are suitable for a NDCT system.	MDCT systems withdraw less water and so are less affected by significant terrain variations. Terrain features of the site are suitable a MDCT system.	Since spray pond construction involves substantial earthwork, such systems are most appropriate for flat or gently rolling terrain. Terrain features of the site are suitable for the addition of spray ponds.
Water Use	The water intake requirements for the NDCT system and the CDWMDCT system are approximately same when the unit is in the Energy Conservation (EC) mode. However, when dry towers are in operation the CDWMDCT system (base case) would have lower evaporative losses.	The water intake requirements for the MDCT system and the CDWMDCT system are approximately same. When dry towers are in operation the CDWMDCT system (base case) would have lower evaporative losses	A spray pond would require large volumes of water and would likely require offsite sources of water.

Factors Affecting System Selection	Natural Draft Cooling Towers (Alternative 3)	Mechanical Draft Cooling Towers (Alternative 4)	Spray Ponds (Alternative 5)
Regulatory Restrictions	An intake structure for an NDCT system would meet Section 316(b) of the CWA and the implementing regulations, as applicable. The VPDES discharge permit thermal discharge limitation to the WHTF would need to be modified to account for the small additional thermal load from NDCT blowdown.	An intake structure for a MDCT system would meet Section 316(b) of the CWA and the implementing regulations, as applicable. The VPDES discharge permit thermal discharge limitation to the WHTF would need to be modified to account for the minor additional thermal load from the MDCT blowdown.	Additional land would have to be obtained and developed to support the spray pond option. The development of this land may entail a substantial and lengthy federal, state, and local permit and approval process.
Atmospheric Effects	An NDCT system would emit water droplets (drift) and intermittently produce a visible plume. The drift droplets would be a minor source of particulate matter and salt deposition. The water vapor plume would not encourage any additional fogging or icing conditions on local road systems. Visible plume aesthetic impacts would be small.	The MDCT system would emit water droplets (drift) and intermittently produce a visible vapor plume. The drift droplets would be a minor source of particulate matter and salt deposition. The water vapor plume would result in minimal additional fogging but no icing conditions on local road systems. Aesthetic impacts from the visible plume would be small.	A spray pond system could produce a low-level visible water droplet plume and encourage formation of fog above the heated pond. These impacts would be localized and short-lived, and consequently small.

Factors Affecting System Selection	Natural Draft Cooling Towers (Alternative 3)	Mechanical Draft Cooling Towers (Alternative 4)	Spray Ponds (Alternative 5)
Thermal and Physical Effects	An NDCT system would produce a small thermal load to the WHTF because 65-85 percent of the heat removal in these towers is associated with evaporation (Reference 2) and most of the remaining heat is dissipated directly to the atmosphere. The NDCT thermal load would be greater than the thermal load from the CDWMDCT system (base case) operating in the Maximum Water Conservation mode. The small NDCT thermal load rejected to the WHTF would be additive to the OT thermal load from the existing units. The VPDES permit thermal discharge criteria would need to be revised to reflect this addition of thermal load.	The MDCT system would discharge a small thermal load to the WHTF because 65–85 percent of the heat removal in cooling towers is associated with evaporation (Reference 2). Most of the remaining heat is dissipated directly to the atmosphere. The MDCT thermal load would be greater than the thermal load from the CDWMDCT system (base case) operating in the Maximum Water Conservation mode. The small MDCT thermal load rejected to the WHTF would be additive to the OT thermal load from the existing units. The VPDES permit thermal discharge criteria would need to be revised to reflect this small thermal load addition.	Since the thermal load would be rejected to the spray pond and that pond would be wholly dedicated to industrial use, the thermal impacts external to the pond would be none to small.
Noise Levels	A NDCT system would produce less noise than a wet and dry tower system because of the absence of fan-generated noise. Construction-related noise impacts would be small.	MDCT operation would generate noise from fan and pump operation and from cascading water in the towers. The results of the Section 5.3.4 noise evaluation suggests that noise impacts for the MDCT will also be below the NRC-defined significance levels (60–65 dBA) at the EAB. Construction related noise impacts would be small.	Spray pond system operation would generate noise from the spray operations. Since the location of the spray ponds and associated receptor boundaries are presently undefined, the associated noise impacts cannot be evaluated at this time. Construction-related noise impacts would be small.

Factors Affecting System Selection	Natural Draft Cooling Towers (Alternative 3)	Mechanical Draft Cooling Towers (Alternative 4)	Spray Ponds (Alternative 5)
Aesthetics and Recreational Benefits	A NDCT system would be wholly situated on the existing NAPS site and its primary external impact would be the discharge of heated water to the North Anna Reservoir via the WHTF. Discharges to the North Anna Reservoir, a popular recreational resource, would produce no tangible aesthetic or recreational benefits.	The MDCT system would be wholly situated on the existing NAPS site and the primary external impact would be the discharge of heated water to the North Anna Reservoir via the WHTF. Discharges to the North Anna Reservoir, a popular recreational resource, would produce no tangible aesthetic or recreational benefits.	The spray ponds would be at least partially situated on land outside of the NAPS site. The resulting commitment of previously undeveloped property to industrial use would produce no tangible aesthetic or recreational benefits.
Operating and Maintenance Experience	NDCT systems are common to older power plants (both fossil and nuclear) and they are considered highly reliable.	MDCT systems are common to power plants (both fossil and nuclear) and are considered highly reliable.	Spray pond systems have been used on power plant sites and they pose no operational and maintenance constraints.
Generating Efficiency Penalty	Natural draft cooling tower energy requirements would be less than the CDWMDCT and the mechanical draft systems. (Reference 5, Tables 3-1 and 3-2)	The energy requirements for mechanical draft cooling towers would be more than the NDCT system but less than the CDWMDCT system because of the potential for operating the dry and wet towers together under certain conditions.	Spray ponds' efficiency penalty is greater than OT systems, but smaller than all the other cooling tower system based alternatives.
Is this a suitable alternative heat dissipation system?	Yes.	Yes	No

Table 9.4-2 Screening of Unit 3 Alternative Heat Dissipation Systems (Alternatives 3 - 6) (continued)

Factors Affecting System Selection	Dry Towers (Alternative 6)
Land Use: Onsite Land Considerations	A dry tower system would require more land than wet cooling tower systems. Dry towers could be situated within the confines of the existing NAPS site.
Land Use: Terrain Considerations	Dry tower systems are unaffected by terrain considerations.
Water Use	A dry tower system would have no comparable evaporative water losses when compared with MDCTs or spray ponds. A dry tower system would require minimal service water.

Factors Affecting System Selection	Dry Towers (Alternative 6)
Regulatory Restrictions	There would be little or no permit or approval-related impacts to the dry tower system alternative.
Atmospheric Effects	A dry tower system would not produce a visible plume or pose particulate emission or salt deposition impacts.

Factors Affecting System Selection	Dry Towers (Alternative 6)
Thermal and Physical Effects	A dry tower system would direct an invisible heated plume of air into the atmosphere, and impacts would be small.
Noise Levels	A dry tower system would generate operational noise from fan operation. The Section 5.3.4 noise evaluation for a dry tower system indicates that noise contributions from a dry tower system would produce impacts below the NRC-defined significance levels (60–65 dBA) at the EAB. Construction-related noise impacts would be small.

Factors Affecting System Selection	Dry Towers (Alternative 6)
Aesthetics and Recreational Benefits	A dry tower system would be wholly situated on the existing NAPS site and their primary external impact would be the discharge of heated air and noise to the atmosphere. These discharges would produce no tangible aesthetic or recreational benefits.
Operating and Maintenance Experience	Dry tower systems are becoming more popular at power plants. Their more limited operating experience indicates that their reliability is similar to wet cooling towers. While dry tower systems are less common, they do not pose any greater operating and maintenance risks than other cooling systems.
Generating Efficiency Penalty	The energy penalty (% reduction in plant output) of dry tower systems would be approximately 7 percent greater than the CDWMDCT system (base case). (extrapolated from Reference 5, Tables 3-1 and 3-2)
Is this a suitable alternative heat dissipation system?	Yes

ER Table 9.4-3, Summary Comparison of Unit 3 Heat Dissipation Systems Impacts. This table summarizes the new base case and alternatives. ER Table 9.4-3 will be revised to read as follows:

[See following pages]

Table 9.4-3 Summary Comparison of Unit 3 Heat Dissipation Systems Impacts

	Base Case	Alternative 1	Alternative 2	Alternative 3	Alternative 4	Alternative 5	Alternative 6
Criteria	**CDWMDCT**	**OT**	**OTHT**	**NDCT**	**MDCT**	**SP**	**Dry Tower**
Land Use	Medium	Low	Low	Low	Medium	High	Medium
Water Use	Medium	High	High	Medium	Medium	High	Low
Regulatory Barriers	Low	High	High	Low	Low	High	Low
Air Impacts	Medium	Low	Low	Medium	Medium	Low	Low
Thermal/Physical Impacts	Low	High	High	Medium	Medium	Medium	Low
Noise Impacts	Medium	Low	Low	Medium	Medium	Low	Medium
Aesthetics & Recreational Benefits	None	None	None	None	None	None	None
Operating and Maintenance Experience	High	High	Medium	High	High	Medium	Low
Generating Efficiency Penalty	Medium	Low	Low	Low	Medium	Low	High
Overall Environmental & Operability Ranking	Preferable	Unacceptable	Unacceptable	Acceptable	Acceptable	Unacceptable	Acceptable

	Base Case	Alternative 1	Alternative 2	Alternative 3	Alternative 4	Alternative 5	Alternative 6
Criteria	**CDWMDCT**	**OT**	**OTHT**	**NDCT**	**MDCT**	**SP**	**Dry Tower**
Capital Costs	Medium	Not evaluated	Not evaluated	Medium	Medium	Not evaluated	High
Operating Costs	Medium	Not evaluated	Not evaluated	Low	Medium	Not evaluated	High
Costs Ranking	Acceptable	Not evaluated	Not evaluated	Acceptable	Acceptable	Not evaluated	Unacceptable
Overall Preference	X						

ER Table 9.4-4, Initial Screening of Alternative Heat Dissipation Systems - Unit 4 (Base Case & Alternatives 6-8). This table is revised to reevaluate the alternative systems. Table 9.4-4 will be revised to read as follows:

[See following pages]

Table 9.4-4 Initial Screening of Alternative Heat Dissipation Systems - Unit 4 (Base Case & Alternatives 7–9)

Factors Affecting System Selection	Dry Towers (Base Case)	Once-Through (Alternative 7)	Once-Through with Helper Tower (Alternative 8)	Natural Draft Cooling Towers (Alternative 9)
Land Use: Onsite Land Considerations	A dry tower system would require more land than a wet cooling tower system. Since dry towers could be situated within the confines of the existing site, impacts would be none to small.	An OT system would have the smallest land requirements.	An OTHT system would require marginally more land than is required by the OT system alone, but less than other cooling tower system. The OTHT system could be placed within the confines of the existing NAPS site.	An NDCT system could be placed within the confines of the existing NAPS site.
Land Use: Terrain Considerations	Dry tower systems are unaffected by terrain considerations.	OT systems require flat or gently rolling terrain to minimize pump head requirements. Terrain features of the site would not preclude the use of an OT system.	OTHT systems require flat or gently rolling terrain situations to minimize pump head requirements. Terrain features of the site are suitable for a OTHT system.	NDCT systems withdraw less water than OT systems and are less affected by substantial terrain variations. Terrain features of the site are suitable for a NDCT system.

Factors Affecting System Selection	Dry Towers (Base Case)	Once-Through (Alternative 7)	Once-Through with Helper Tower (Alternative 8)	Natural Draft Cooling Towers (Alternative 9)
Water Use	Dry tower systems have no comparable evaporative water losses when compared with MDCTs or spray ponds. Dry tower systems require minimal service water.	A OT system would require nearly 50 times more water than the MDCT system. Despite this increased water intake requirement, a OT system would return most of the water withdrawn, while the MDCT system would lose a considerable portion of the lesser water withdrawal to the atmosphere through evaporation. Hydrological and thermal modeling results (Section 3.4.1) indicate that Lake Anna cannot support operation of Unit 4 with OT cooling.	A OTHT system would require less water than a pure OT system. Despite this reduction, hydrological/thermal modeling results (Section 3.4.1) indicate that Lake Anna cannot support operation of Unit 4 with this modified OT system.	A OT system would require nearly 50 times more water than a NDCT system. Despite the reduced water intake requirements, a NDCT system would lose a considerable portion of the lesser water withdrawal to the atmosphere through evaporation. The overall evaporative losses would be somewhat greater for closed wet cooling tower systems compared to open cooling systems.

Factors Affecting System Selection	Dry Towers (Base Case)	Once-Through (Alternative 7)	Once-Through with Helper Tower (Alternative 8)	Natural Draft Cooling Towers (Alternative 9)
Regulatory Restrictions	There are little or no permit or approval-related impacts to the dry tower system alternative.	An intake structure for OT system would meet Section 316(b) of the CWA and the implementing regulations, as applicable. Since the thermal load contribution of a Unit 4 OT system could produce undesirably high temperatures in the WHTF, it is unlikely that an additional once-through system could be successfully permitted.	An intake structure for OTHT system would meet Section 316(b) of the CWA and the implementing regulations, as applicable. While the helper tower for Unit 4 would temper the thermal loading to the WHTF during the hottest summer season periods, it is unlikely that an additional once-through system could be successfully permitted.	Although the water withdrawal of the NDCT is moderate, Lake Anna does not have the capacity to provide a water source for this cooling option. A supplemental source of cooling water would be required during drought conditions to maintain minimum lake levels and downstream flows. The need for a supplemental source of cooling water would result in additional impacts, such as consumption of water from remote supplies and the impacts of transporting the water (e.g., the impacts of building a pipeline). In the absence of any identifiable and readily available source, this alternative is not deemed feasible.

Factors Affecting System Selection	Dry Towers (Base Case)	Once-Through (Alternative 7)	Once-Through with Helper Tower (Alternative 8)	Natural Draft Cooling Towers (Alternative 9)
Atmospheric Effects	Dry towers systems do not produce visible plume or pose particulate emission or salt deposition impacts.	Since OT systems do not produce a visible water droplet plume and the associated pond induced fogging (steam fog) would be minimal, atmospheric effects would be none to small.	An OTHT system would emit water droplets (drift) and produce visible plumes during periods when the helper tower is in operation. The particulate, salt deposition, and fogging and aesthetic impacts would not be significant from the infrequent/intermittent operation of this small cooling tower.	An NDCT system would emit water droplets (drift) and may intermittently produce a visible plume. The drift droplets would be a minor source of particulate matter and salt deposition. The water vapor plume would not encourage any additional fogging or icing conditions on local road systems. Visible plume aesthetic impacts would be small.
Thermal and Physical Effects	A dry tower system would direct an invisible heated plume of air into the atmosphere, and impacts would be none to small.	Hydrological and thermal modeling results (Section 3.4.1) indicate that Lake Anna cannot support operation of Unit 4 with an OT system.	While an OTHT system would minimize the thermal loading to the WHTF during the hottest summer season periods, hydrological/thermal modeling results (Section 3.4.1) indicate that Lake Anna cannot support operation of Unit 4 with this modified OT system.	An NDCT system would produce a significantly smaller thermal load on the WHTF (compared to OT systems) because 65-85 percent of the heat removal in cooling towers is associated with evaporation (Reference 2). Most of the remaining heat is dissipated directly to the atmosphere. In this case the smaller NDCT thermal load rejected to the WHTF would be additive to the existing OT thermal load. The VPDES permit thermal discharge criteria would need to be revised to reflect this minor thermal addition.

Factors Affecting System Selection	Dry Towers (Base Case)	Once-Through (Alternative 7)	Once-Through with Helper Tower (Alternative 8)	Natural Draft Cooling Towers (Alternative 9)
Noise Levels	The Section 5.3.4 noise evaluation for a dry tower system indicates that noise contributions from this system would produce impacts below the NRC-defined significance levels (60–65 dBA) at the EAB. Construction-related noise impacts would be small.	OT system operation would generate minimal noise from pump operation. Construction-related noise impacts would be small.	OTHT operation would generate noise from fan and pump operation and from cascading water in the towers during the periods when the helper tower is needed. The associated noise impacts would be less than dry towers impacts which were below the NRC-defined significance levels (60–65 dBA) at the EAB as described in Section 5.3.4. Construction-related noise impacts would be small.	An NDCT system would produce less noise than a dry tower system because of the absence of fan generated noise. Dry tower noise levels were evaluated to be below NRC-defined significance levels (60–65 dBA) at the EAB (see Section 5.3.4). Construction-related noise impacts would be small.
Aesthetics and Recreational Benefits	A dry tower system would be wholly situated on the existing NAPS site and its primary external impact would be the discharge of heated air and noise to the atmosphere. These discharges would not produce tangible aesthetic or recreational benefits.	An OT system would be wholly situated on the existing NAPS site and its primary external impact would be the discharge of heated water to the North Anna Reservoir via the WHTF. Discharges to the North Anna Reservoir, a popular recreational resource, would produce no tangible aesthetic or recreational benefits.	An OTHT system would be wholly situated on the existing NAPS site and its primary external impact would be the discharge of heated water to the North Anna Reservoir via the WHTF. Discharges to the North Anna Reservoir, a popular recreational resource, would produce no tangible aesthetic or recreational benefits.	An NDCT system would be wholly situated on the existing NAPS site and its primary external impact would be the discharge of heated water to the North Anna Reservoir via the WHTF. Discharges to the North Anna Reservoir, a popular recreational resource, would produce no tangible aesthetic or recreational benefits.

Factors Affecting System Selection	Dry Towers (Base Case)	Once-Through (Alternative 7)	Once-Through with Helper Tower (Alternative 8)	Natural Draft Cooling Towers (Alternative 9)
Operating and Maintenance Experience	Dry tower systems are becoming more popular at power plants. Their more limited operating experience indicates that their reliability is similar to wet cooling towers. While dry tower systems are less common, they do not pose any greater operating and maintenance risks than other cooling systems.	OT systems are common to power plants (both fossil and nuclear) and they are considered highly reliable.	While OTHT systems are less common than OT systems, they do not pose any greater operating and maintenance risks than other cooling tower systems.	NDCT systems are common to power plants (both fossil and nuclear) and they are considered highly reliable.
Generating Efficiency Penalty	The energy penalty (% reduction in plant output) of dry tower systems versus wet tower systems is 6.8 to 9.6 percent. The energy penalty of dry tower systems versus OT systems is 8.5 to 11.4 percent. (Reference 5, Tables 3-1 and 3-2)	The energy penalty (% reduction in plant output) of dry tower systems versus OT systems is 8.5 to 11.4 percent. (Reference 5, Tables 3-1 and 3-2)	The additional energy requirements associated with cooling tower operation do not alter this system's energy efficiency advantages over wet cooling tower only systems.	The energy penalty (% reduction in plant output) of dry tower systems versus wet cooling tower systems is 6.8 to 9.6 percent. (Reference 5, Tables 3-1 and 3-2)
Is this a suitable heat dissipation system?	Yes	No	No	No

Table 9.4-5, Screening of Unit 4 Alternative Heat Dissipation Systems (Alternatives 9 & 10). This table is revised to reevaluate the alternative systems. The Alternative numbering scheme of Table 9.4-5 will be revised to read as follows:

[See following pages]

Table 9.4-5 Screening of Unit 4 Alternative Heat Dissipation Systems (Alternatives 10 & 11)

Factors Affecting System Selection	Mechanical Draft Cooling Towers (Alternative 10)	Spray Pond (Alternative 11)
Land Use: Onsite Land Considerations	An MDCT system would require more land to site widely spaced towers. An MDCT system could be placed within the confines of the existing NAPS site property.	The spray pond cooling alternative would involve the development of significant additional surface water impoundments and consequently pose the greatest new land requirements. It is unlikely that spray ponds of sufficient size could be placed within the confines of the existing site.
Land Use: Terrain Considerations	MDCT systems withdraw less water than OT systems and are less affected by substantial terrain variations. Terrain features of the site are suitable for an MDCT system.	Since spray pond construction involves substantial earthwork, such systems are most appropriate for flat or gently rolling terrain. Terrain features of the site are suitable for the addition of spray ponds.
Water Use	Per the PPE, a OT system would require nearly 50 times more water than an MDCT system. Despite the reduced water intake requirements, an MDCT system would lose a considerable portion of the lesser water withdrawal to the atmosphere through evaporation. The overall evaporative losses are somewhat greater for closed wet cooling tower systems compared to open cooling systems.	Spray ponds would require large volumes of water and would likely require offsite sources of water.

Factors Affecting System Selection	Mechanical Draft Cooling Towers (Alternative 10)	Spray Pond (Alternative 11)
Regulatory Restrictions	Although the water withdrawal of the MDCT is moderate, Lake Anna does not have the capacity to provide a water source for this cooling option. A supplemental source of cooling water would be required during drought conditions to maintain minimum lake levels and downstream flows. The need for a supplemental source of cooling water would result in additional impacts, such as consumption of water from remote supplies and the impacts of transporting the water (e.g., the impacts of building a pipeline). In the absence of any identifiable and readily available source, this alternative is not deemed feasible.	Additional land would have to be obtained and developed to support a spray pond option. The development of this land would entail a substantial and lengthy federal, state, and local permit and approval process.
Atmospheric Effects	An MDCT system would emit water droplets (drift) and intermittently produce a visible plume. The drift droplets would be a minor source of particulate matter and salt deposition. The water vapor plume is expected to encourage some minor supplemental hours of fogging annually and no icing conditions on local roads would encourage some additional fogging. Visible plume aesthetic impacts would be small.	Spray pond systems could produce a low-level visible water droplet plume and encourage formation of fog above the heated pond. These impacts would be localized and short-lived, and consequently small.
Thermal and Physical Effects	An MDCT system would produce a significantly smaller thermal load on the WHTF (compared to OT systems) because 65–85 percent of the heat removal in cooling towers is associated with evaporation (Reference 2). Most of the remaining heat is dissipated directly to the atmosphere. In this case the smaller MDCT thermal load rejected to the WHTF would be additive to the existing OT thermal load. The VPDES permit thermal discharge criteria would need to be revised to reflect this minor thermal addition.	Since the thermal load would be rejected to the spray pond that would be wholly dedicated to industrial use, the thermal impacts external to the pond would be none to small.

Factors Affecting System Selection	Mechanical Draft Cooling Towers (Alternative 10)	Spray Pond (Alternative 11)
Noise Levels	MDCT operation would generate noise from fan and pump operation and from cascading water in the towers. Results from a noise impact analysis of dry towers operation described in Section 5.3.4 suggest that MDCT impacts will be below the NRC-defined significance levels (60–65 dBA) at the EAB. Construction-related noise impacts would be small.	Spray pond system operation would generate noise from the spray operations. Since the location of the spray ponds and associated receptor boundaries are presently undefined, the associated noise impacts cannot be evaluated at this time. Construction-related noise impacts would be small.
Aesthetics and Recreational Benefits	An MDCT system would be wholly situated on the existing NAPS site and its primary external impact would be the discharge of heated water to the North Anna Reservoir via the WHTF. Discharges to the North Anna Reservoir, a popular recreational resource, would produce no tangible aesthetic or recreational benefits.	The spray ponds would be at least partially situated on land outside of the NAPS site. The resulting commitment of previously undeveloped land to industrial use would produce no tangible aesthetic or recreational benefits.
Operating and Maintenance Experience	MDCT systems are common to power plants (both fossil and nuclear) and they are considered highly reliable.	Spray pond systems have been used on power plant sites and they pose no operational or maintenance constraints.
Generating Efficiency Penalty	The energy penalty (% reduction in plant output) of dry tower systems versus wet cooling tower systems is 6.8 to 9.6 percent. (Reference 5, Tables 3-1 and 3-2)	Spray ponds' efficiency penalty is greater than OT systems, but smaller than all the other cooling tower system based alternatives.
Is this a suitable heat dissipation system?	No	No

ER Table 9.4-6, Summary Comparison of Unit 4 Heat Dissipation Systems Impacts. This table is revised to reevaluate the alternative systems. ER Table 9.4-6 will be revised to read as follows:

[See following pages]

Table 9.4-6 Summary Comparison of Unit 4 Heat Dissipation Systems Impacts

	Base Case	Alternative 7	Alternative 8	Alternative 9	Alternative 10	Alternative 11
Criteria	**Dry Towers**	**OT**	**OTHT**	**NDCT**	**MDCT**	**SP**
Land Use	Medium	Low	Low	Medium	Medium	High
Water Use	Low	High	High	Medium	Medium	High
Regulatory Barriers	Low	High	High	High	High	High
Air Impacts	Low	None	Low	Medium	Medium	Low
Thermal/Physical Impacts	Low	High	High	Medium	Medium	Medium
Noise Impacts	Medium	Low	Low	Medium	Medium	Low
Aesthetics & Recreational Benefits	None	None	None	None	None	None
Operating and Maintenance Experience	Low	High	Medium	High	High	Medium
Generating Efficiency Penalty	High	Low	Low	Medium	Medium	Low
Overall Environmental & Operability Ranking	Preferable	Unacceptable	Unacceptable	Unacceptable	Unacceptable	Unacceptable

	Base Case	Alternative 7	Alternative 8	Alternative 9	Alternative 10	Alternative 11
Criteria	**Dry Towers**	**OT**	**OTHT**	**NDCT**	**MDCT**	**SP**
Capital Costs	High	Not Evaluated	Not Evaluated	Not Evaluated	Not Evaluated	Not Evaluated
Operating Costs	High	Not Evaluated	Not Evaluated	Not Evaluated	Not Evaluated	Not Evaluated
Costs Ranking	Preferable	Not Evaluated	Not Evaluated	Not Evaluated	Not Evaluated	Not Evaluated
Overall Preference	X					

ER Table 9.4-9, Screening of Alternatives to the Proposed Discharge System (Base Case & Alternative 4). This table is revised to reevaluate the alternative systems. The title of the Intake System Alternative column of ER Table 9.4-9 will be revised to reads as follows:

Table 9.4-9 Screening of Alternatives to the Proposed Discharge System (Base Case & Alternative 4)

Factors Affecting System Selection	Discharge System –Base Case	Discharge System - Alternative 4
	Shoreline Discharge & Discharge Canal	Offshore Submerged Discharge System
Construction Impacts	Since development of the shoreline discharge would result in disruptions of the littoral zone (area of more concentrated biological resources), there could be localized moderate adverse impacts on this disturbed zone.	If the offsite discharge system is installed using an open trench system, there could be large adverse impacts on both the littoral zone and other areas of the lake. Open trench activities would result in greater lakebed disruptions and larger increases in the turbidity of Lake Anna water. The resulting adverse impact on the lake water quality could be large during the construction phase of work.
Aquatic Impacts	Situated in the more biologically important littoral zone areas, shoreline discharges would have the potential to disturb the local aquatic ecosystem. Such systems pose greater impacts than offshore discharge systems.	Situated in areas with relatively less abundant aquatic resources (outside of more ecologically abundant littoral zone), submerged offsite intake systems generally pose fewer impacts on the aquatic ecosystem.
Land Use Impacts	Since the commitment of land for the shoreline discharge is not significant, land use impacts would not be an important differentiating factor.	Though offshore discharge systems have somewhat lesser land requirements than shoreline discharge systems, land use impacts would not be an important differentiating factor. Note that the submerged systems would likely be situated deep enough to avoid direct interference with recreational water uses.
Water Use Impacts	The relative position of the shoreline discharge would have little impact on the water use requirements and, therefore, it would not be an important differentiating factor.	The relative position of the discharge would have little impact on the water use requirements and, therefore, it would not be an important differentiating factor. Note that the submerged systems would likely be situated deep enough to avoid direct interference with recreational water uses.

Factors Affecting System Selection	Discharge System –Base Case Shoreline Discharge & Discharge Canal	Discharge System - Alternative 4 Offshore Submerged Discharge System
Compliance with Regulations	The discharge system would meet the requirements of Section 316(a) of the CWA, and the implementing regulations, as applicable. The applicable VPDES permit and Section 316(a) thermal impact considerations would need to be evaluated in response to the additional discharge. These regulatory restrictions would not be an important differentiating factor.	The discharge system would meet the requirements of Section 316(a) of the CWA, and the implementing regulations, as applicable. The applicable VPDES permit and Section 316(a) thermal impact considerations would need to be evaluated in response to the additional discharge. These regulatory restrictions would not be an important differentiating factor.
Environmentally preferred or equivalent?	Yes	No

ER Table 9.4-10, Screening of Alternatives to the Proposed Discharge System Location (Base Case & Alternatives 5 & 6). This table is revised to reevaluate alternative systems. The Water Use Impacts portion of ER Table 9.4-10 has been revised to read as follows:

[See following pages]

Table 9.4-10 Screening of Alternatives to the Proposed Discharge System Location (Base Case & Alternatives 5 & 6)

Factors Affecting Location Selection	Discharge Location Base Case	Discharge Location Alternative 5	Discharge Location Alternative 6
	Adjacent to Existing Discharge	**Discharge along WHTF**	**Discharge on Lake Anna**
Construction Impacts	Construction impacts would be minimized if the discharge structure is located adjacent to the existing discharge structure at the head of the discharge canal. Already cleared and graded in support of the original discharge system, this area boasts less ecological resources than other undeveloped areas.	Construction impacts (surface disruption and turbidity increases) would be more significant at less developed alternative discharge structure sites along the WHTF shoreline.	Construction impacts (surface disruption and turbidity increases) would be the greatest for the undeveloped or less developed alternative shoreline discharge structure sites along the shore of Lake Anna.
Aquatic Impacts	The thermal and chemical impacts of effluent discharges would be effectively mitigated (through mixing and dilution) in the discharge canal and downstream WHTF.	The thermal and chemical impacts of effluent discharges would be effectively mitigated (mixing and dilution) in the WHTF.	Effluent that is discharged directly to Lake Anna may significantly impact local aquatic resources, since the effluent would not be subject to the beneficial mixing and dilution actions from travel through the discharge canal and WHTF.
Land Use Impacts	Since the new discharge would reside totally within the confines of the NAPS site, its location adjacent to another discharge structure would pose the smallest land use impacts.	Although the new discharge would reside totally within the confines of the NAPS site, its location along a relatively undeveloped shoreline of the WHTF would require a greater commitment of land resources.	Land use designations along Lake Anna areas outside the NAPS site do not support the installation or operation of industrial facilities. The lake also offers substantial recreational benefits to the local community, which could be adversely impacted by the construction of a discharge structure. Thus, development of discharge systems in these more ecological important and community-valued areas would trigger potentially onerous land use amendment processes.

Factors Affecting Location Selection	Discharge Location Base Case Adjacent to Existing Discharge	Discharge Location Alternative 5 Discharge along WHTF	Discharge Location Alternative 6 Discharge on Lake Anna
Water Use Impacts	The additional effluent released through the discharge structure would pose the smallest water use and cumulative impacts since the release is consistent with current discharge practices into the WHTF; an industrial facility already designed and constructed to receive heat dissipation system discharges.	The additional effluent released to the WHTF in an alternate location would pose the smallest water use impacts, because this activity is consistent with current discharge practices into the WHTF; an industrial facility designed and constructed to receive heat dissipation system discharges.	The new discharge of effluent directly to Lake Anna could have moderate water use impacts to this receiving water body. Lake Anna is a multi-use water resource that is not compatible with direct industrial discharges. Note the thermal and chemical impacts of this discharge would not be subject to the beneficial dilution and mixing actions from travel through the discharge canal and WHTF.
Compliance with Regulations	The discharge system would meet the requirements of Section 316(a) of the CWA, and the implementing regulations, as applicable. The applicable VPDES permit and current associated 316(a) considerations would need to be modified in response to the additional discharge system. These regulatory restrictions would offer only small impacts to the design and operation of a new a discharge system sited with the existing discharge canal.	The discharge system would meet the requirements of Section 316(a) of the CWA, and the implementing regulations, as applicable. The applicable VPDES permit and current associated 316(a) considerations would need to be modified to respond to the additional discharge system. These regulatory restrictions would offer only small impacts to the design and operation of a new discharge system sited in the WHTF.	The discharge system would meet the requirements of Section 316(a) of the CWA, and the implementing regulations, as applicable. Since construction of the discharge structure is likely to impact wetland and important habitat areas, additional federal and state-sponsored permitting processes could also be triggered. The environmental permitting process for this discharge structure location could represent a barrier to development.
Environmentally preferred or equivalent?	Yes	No	No

ER Table 9.4-11, Screening of Alternatives to the Proposed Water Treatment System (Base Case & Alternatives 7 & 8). This table is revised to remove reference to the once-through cooling system. ER Table 9.4-11 will be revised to read as follows:

[See following pages]

Table 9.4-11 Screening of Alternatives to the Proposed Water Treatment System (Base Case & Alternatives 7 & 8)

Factors Affecting System Selection	Water Treatment Base Case Mechanical Condenser Cleaning	Water Treatment System Alternative 7 Chemical Treatment: Biocide, Corrosion Inhibitor, pH Adjustment	Water Treatment System Alternative 8 Non-chemical Treatment: Ultraviolet (UV) Treatment
Chemicals Used	Mechanical cleaning would involve periodic removal of organic and inorganic residue and debris on circulating system condenser piping and related equipment. No chemicals are used.	Biocide – chlorine, sodium-hypochlorite, ozone Corrosion inhibitors (cooling tower systems only) – oxidizer (nitrates, molybates), filming (nitrogen compounds), polymer (polymeric carboxylate). pH adjustment (cooling tower systems only) – acids (sulfuric acid) and caustics (sodium hydroxide) (Reference 4)	None
Construction Impacts	Periodic mechanical cleaning of the condenser system would not require any substantial construction activities and there would be no related environmental impacts.	Installation of the chemical treatment systems would result in additional commitments of land. Associated soil erosion and sediment impacts, however, would be small.	Installation of the UV treatment systems would result in additional commitments of land. Associated soil erosion and sediment impacts, however, would be small.
Aquatic Impacts	While mechanical cleaning measures would remove biological materials from condenser system surfaces, these measures would not pose systemic impacts on aquatic resources in Lake Anna.	Residual chemicals from this treatment process could impact aquatic resources in the WHTF and downstream North Anna Reservoir. Biocides, corrosion inhibitors, and pH adjustment chemicals are potentially toxic to aquatic life. Polymeric corrosion inhibitors are proposed and would represent a much less toxic option. (Reference 4)	The UV treatment would have no residual impacts on aquatic resources in the receiving body of water. UV systems, however, have not been proven effective on large-scale cooling systems; therefore, they may prove infeasible or unreliable.

Factors Affecting System Selection	Water Treatment Base Case Mechanical Condenser Cleaning	Water Treatment System Alternative 7 Chemical Treatment: Biocide, Corrosion Inhibitor, pH Adjustment	Water Treatment System Alternative 8 Non-chemical Treatment: Ultraviolet (UV) Treatment
Land Use Impacts	Mechanical cleaning measures would not require any additional commitment of land.	Since the chemical treatment systems do require additional land, these systems would be wholly-confined to the existing NAPS site. There would be no appreciable land use impacts.	While these UV treatment systems do require additional land, these systems would be wholly-confined to the existing NAPS site. There would be no appreciable land use impacts.
Water Use Impacts	Mechanical cleaning would not impact water withdrawal requirements.	Chemical treatment systems would not impact water withdrawal requirements.	UV treatment systems would not impact water withdrawal requirements.
Compliance with Regulations	Mechanical condenser cleaning is a continuation of current practice and fully compliant with the applicable regulations and existing and pending permit conditions.	The addition of chemical treatment systems would impact the current NAPS VPDES discharge permit. This permit would need to be revised in response to the revised characterization of the chemically-treated cooling system effluent.	The addition of UV treatment systems may impact the current NAPS VPDES discharge permit. This permit may need to be revised in response to the new characterization of the treated cooling system effluent.
Environmentally preferred or equivalent?	Yes	Yes	No

ER Table 10.1-2, Operations-Related Unavoidable Adverse Environmental Impacts. This table is revised to summarize the reevaluated adverse impact and mitigation measures associated with a combined dry and wet cooling tower system. ER Table 10.1-2 will be revised to read as follows:

[See following pages]

Table 10.1-2 Operations-Related Unavoidable Adverse Environmental Impacts

Category/ESP ER Section	Adverse Impact	Mitigation Measure	Unavoidable Adverse Environmental Impacts
Land Use/ Section 5.1.1	Potential for additional waste heat to affect recreational use of Lake Anna	The change in temperature at the discharge point of WHTF due to operation of new units would be negligible Design/operate cooling system to comply with VPDES permit requirements.	N
Section 5.1.1	Increased traffic could create need for changes to local road system	Effective traffic management should avoid need for changes.	N
Transmission Lines/ Section 5.1.2	Based on an initial evaluation, the existing transmission lines and corridors have sufficient capacity for the total output of the existing and new units.	None required.	N
Historic, Cultural, or Archaeological Resources/ Section 5.1.3	None expected	None required.	N
Hydrological Alterations and Water Supply/ Section 5.2.1	Potential reduction in available water released from the North Anna Dam from current values (permit limits maintained)	Assess practices to minimize the hydrologic alterations and their implementation.	Y
Section 5.2.1	Potential reduction in Lake Anna water levels from current values during periods of extended drought with existing and new units operating	·During periods of extended drought, dry cooling towers would be put into service to dissipate a portion of waste heat from Unit 3 to minimize the make-up water requirements	N

Category/ESP ER Section	Adverse Impact	Mitigation Measure	Unavoidable Adverse Environmental Impacts
Water-Use Impacts/ Section 5.2.2	Discharge of dissolved solids above ambient levels	There would be no appreciable water quality impacts due to blowdown from the Unit 3 wet cooling towers. There would be no blowdown from the Unit 3 and Unit 4 dry cooling towers.	N
Make-up Water Intake System Physical Impacts/ Section 5.3.1.1	Scouring of the lake bottom and erosion of shoreline due to operation of new unit(s)' intake system	As for existing units, construct new make-up water intake system and intake structure in a cove on the south shore of Harris Creek. Install intake system for new units in area planned for intake system of previously abandoned Units 3 and 4. Stabilize the banks of the channel to the screens and pump house during construction.	N
Make-up Water Intake System Aquatic Impacts/ Section 5.3.1.2	Increased impingement of fish and increased entrainment of larva	Predicted effects are minimal for increased impingement and small for increased entrainment due to stable, healthy, and diverse fish population in Lake Anna.	N
Blowdown Water Discharge System/ Thermal Description and Physical Impacts/ Section 5.3.2.1	Installation of Unit 3 Dry and Wet Cooling system and Unit 4 Dry Cooling Tower would result in negligible temperature increases in the North Anna Reservoir and the WHTF.	The cooling system for the new units will not have an adverse effect on the North Anna reservoir and the WHTF. Blowdown from the Unit 3 wet cooling towers will be discharged to the WHTF at the cold water temperature of the cooling tower.	N
Section 5.3.2.1	Potential for scouring of lake bed or erosion of shoreline at Dike 3 if multiple units are constructed with wet and dry cooling system would be very small	The first new unit would use a combination wet and dry cooling system. The second unit would be designed with dry towers as the cooling system. The intake flow rate would be for wet cooling tower make-up and the velocity would be relatively low.	N

Category/ESP ER Section	Adverse Impact	Mitigation Measure	Unavoidable Adverse Environmental Impacts
Section 5.3.2.1	Potential increased turbidity due to blowdown flows from discharges of new units would be very small	Design new cooling systems' blowdown such that the flow velocities are low to minimize the potential for increased turbidity.	N
Aquatic Ecosystem Impacts/ Section 5.3.2.2	Scouring and sediment transport due to water discharge flows is very low due to combination wet and dry cooling towers	None required. Flow velocities associated with cooling tower blowdown will be relatively low.	N
Section 5.3.2.2	Impacts due to increase in chemicals and other pollutants contained in discharge from new units	Maintain compliance with VPDES water quality standards and permitted discharge limits for cooling water discharges to Lake Anna.	N
Section 5.3.2.2	Impacts due to increase in thermal discharges or sudden changes in discharge temperatures	Maintain compliance with VPDES water quality standards and permitted discharge limits for cooling water discharges to Lake Anna No impact on overall fish population in Lake Anna. Typical operations of a nuclear power plant would limit sudden changes in discharge temperatures as such units do not come on and off-line regularly.	N
Heat Discharge System/ Dissipation to Atmosphere/ Section 5.3.3.1	Visual impact of wet and dry towers, e.g., visible plumes and steam fog, and icing and salt deposition	Design and install the wet and dry towers incorporating industrial standard measures indicated from the visual impact study to be performed during the design phase of the project. Most of the fogging from the wet cooling tower would occur within the site boundary in winter and spring seasons No icing is anticipated within or beyond site boundary.	N

Category/ESP ER Section	Adverse Impact	Mitigation Measure	Unavoidable Adverse Environmental Impacts
		Salt deposition rates would be below threshold value beyond the site boundary at ground levels. Industry standard techniques would be implemented during final design to reduce fogging to be within reasonable levels.	
Terrestrial Ecology/ Section 5.3.3.2	Noise from wet and dry cooling towers could cause some wildlife to avoid the site	Wildlife expected to adapt to normal operating noise variations as for existing units.	N
Section 5.3.3.2	Reduction in moisture content of the air due to the dry hot exhaust from cooling tower could result in dieback of vegetation	None. If there are any impacts, they would be close to the dry towers, and there are no important species near the cooling towers.	N
Section 5.3.3.2	Decreased local precipitation due to hot exhaust from dry towers	Any impacts from decreased precipitation would be localized to the NAPS site, which does not contain important species.	N
Section 5.3.3.2	Avian collisions with cooling towers	Negligible impacts from collisions with wet and dry towers that would be lower in height than existing or proposed onsite structures.	N
Impacts to Members of the Public/ Section 5.3.4	Increased thermal discharges from wet cooling towers could affect composition micro-organisms in Lake Anna, thereby also affecting recreational use of the lake	Analyses show that there would be no significant alteration of the temperature regime in the lake or the surrounding environment and that the additional Units would not contribute to an environment conducive to the reproduction and growth of thermophilic micro-organisms.	N

Category/ESP ER Section	Adverse Impact	Mitigation Measure	Unavoidable Adverse Environmental Impacts
Section 5.3.4	Discharge of pathogenic materials in wastewater and/or sanitary wastes	The recently upgraded onsite sewage treatment plant that includes disinfection to reduce coliform bacteria and other micro-organisms to levels that meet Virginia water quality standards, would prevent adverse impacts from sanitary wastes.	N
Section 5.3.4	Offsite noise impacts from cooling system operation	Modeled peak noise levels from operation of all of the cooling systems are below the applicable NRC-defined significance levels at the EAB.	N
Radiological Impacts from Normal Operations/ Exposure Pathways/ Section 5.4.1	Direct dose to population and environment	Shielding of new units would be at least as effective of that of existing units so direct dose contribution from the new units is expected to be negligible compared to those from liquid and gaseous effluent pathways or from natural and artificial sources outside the NAPS site	N
Impacts to Members of the Public/ Section 5.4.3	Doses due to liquid effluent releases to the discharge canal and the WHTF and from gaseous pathway releases	Calculated doses to public via liquid and gaseous pathways are within the design objectives of 10 CFR 50 Appendix I and within regulatory limits of 40 CFR 190.	N
Impacts to Biota Other Than Members of the Public/ Section 5.4.4	Doses to biota from liquid radwaste effluent releases to the discharge canal, WHTF, and the North Anna Reservoir	There are no acceptance criteria specifically for biota. However, there is no scientific evidence that chronic dose rates below 100 mrad/day are harmful to plants and animals and all biota doses are calculated to be less than 1 mrad/day. No mitigation measures or controls are proposed.	N

Category/ESP ER Section	Adverse Impact	Mitigation Measure	Unavoidable Adverse Environmental Impacts
Environmental Impacts of Waste/ Nonradioactive Waste System Impacts/ Section 5.5.1	Potential impacts to Lake Anna and North Anna River from increased volume of effluent discharged and increased amounts of chemicals and other pollutants in the discharged effluent as well as increased storm water discharge	Comply with applicable VPDES water quality standards for discharges from Dike 3. Prepare and implement a Storm Water Pollution Prevention Plan for the operation of the existing and new units to avoid and/or minimize releases of contaminated storm water.	N
Section 5.5.1	Potential increase in impacts due to increase in gaseous and particulate emissions	Operate new minor air emission sources in accordance with applicable regulations and permits.	N
Section 5.5.1	Increase in total volume of solid and sanitary wastes	Continue use of approved transporters and offsite landfills for disposal of solid wastes. Continue existing units program for reuse and recycling of non-radwastes. Modify existing sanitary waste treatment systems, as required, to accommodate increased volume.	N
Mixed Wastes Impacts/ Section 5.5.2	Potential hazardous chemical and occupational exposure to radiological materials during handling and storage of 15-30 cubic feet of mixed liquid waste and 5-10 cubic feet of mixed solid waste generated by operation activities for new unit(s)	Limit amounts of mixed waste to be handled and disposed of through source reduction, recycling, and treatment, to the extent practical and feasible. Develop a Waste Minimization Program that includes new and existing units. Construct temporary onsite storage facilities, as needed, for mixed wastes and implement a waste management program in compliance with applicable EPA and NRC requirements. Identify a primary and an alternative offsite facilities for transportation, treatment and disposal of mixed wastes.	N

Category/ESP ER Section	Adverse Impact	Mitigation Measure	Unavoidable Adverse Environmental Impacts
Section 5.5.2	Potential exposure of onsite workers and emergency response personnel during accidental releases and cleanup activities	Implement, or comply with existing, spill prevention and response plans and procedures that address hazards associated with managing/handling mixed wastes. Include measures for response personnel training and protective equipment.	N
Transmission System Impacts/ Terrestrial Ecosystems/ Section 5.6.1	Air emissions and noise from use of helicopter to maintain transmission corridors	No new measures are required as current maintenance activities are sufficient.	N
Aquatic Ecosystems/ Section 5.6.2	Potential impacts to mussel species from maintenance of transmission corridors	No new measures are required as current maintenance practices would continue.	N
Impacts to Members of the Public/ Section 5.6.3	Dependent on design of transmission corridors and a determination whether any changes are required.	Based on an initial evaluation, the current ESP site transmission lines and corridors have sufficient capacity for the total output of the existing and new units.	N/A
Uranium Fuel Cycle Impacts (relative to reference LWR)/ Section 5.7	Energy required, emissions generated, and water usage during mining, yellowcake production and uranium conversion; and production of UO_2 during fuel fabrication.	Select mining techniques, where feasible and practical, that minimize impacts such as in situ leaching rather than open pit mining. Consider use of new technology that requires less UF_6. Consider use of new technologies with less fuel loading to reduce energy, emissions, and water usage	Y

Category/ESP ER Section	Adverse Impact	Mitigation Measure	Unavoidable Adverse Environmental Impacts
Section 5.7	Emissions from fossil fuel plants supplying the gaseous diffusion plant	Consider use of new technology that requires less UF_6. Consider use of centrifuge process rather than gaseous diffusion process which significantly reduces energy requirements and environmental impacts. Fossil fuel plants must comply with air quality regulations.	N
Section 5.7	Radioactive waste to be managed from operations, and decontamination and decommissioning	Consider use of new gas-cooled reactor technologies that can result in generation of far less low-level wastes.	Y
Physical Impacts of Station Operations/ Section 5.8.1	Potential noise impact from operating plant activities	Noise from cooling towers is expected to be below NRC-defined significance levels at the NAPS site EAB and nearest residence. Perform noise study as part of the design of the cooling system to confirm compliance with NRC-defined levels, and apply controls if necessary. Control noise levels in accordance with local noise regulations.	N
Section 5.8.1	Potential air quality impacts from emissions associated with diesel generators and auxiliary power systems	Comply with applicable VDEQ permit limits and regulations to install and operate such sources.	N
Section 5.8.1	Potential visual impacts to surrounding areas due to new structures, including wet and dry towers	Perform visual impact study during final plant design, and incorporate mitigation measures, as appropriate.	N
Section 5.8.1	Potential traffic impacts on local roads	Existing roads are expected to have sufficient capacity to handle increased traffic due to operation of new units.	N

Category/ESP ER Section	Adverse Impact	Mitigation Measure	Unavoidable Adverse Environmental Impacts
Socioeconomic/ Section 5.8.2	Noise impacts at residences from operation of the new units and ancillary facilities, e.g., cooling tower	Due to distance to nearest residences, no noticeable increase in noise levels. A noise study would be performed for the area once the reactor and ancillary facilities are selected. If indicated, noise mitigation measures would be designed into facility.	N
Section 5.8.2	Visual impact of new units	Selection of cooling tower, reactor. Perform visual impact assessment prior to construction to assist in facility layout.	N
Section 5.8.2	Impact of increased operations traffic on local road network	Operations traffic management study plus any permanent upgrades for the construction phase should eliminate any adverse impact on the local road network.	N
Environmental Justice/ Section 5.8.3	None expected	None required.	N
Decommissioning/ Section 5.9	Potential radiation exposure related to decommissioning, including transportation of materials to authorized disposal sites	No mitigation measures are proposed at this time as this would be part of the required decommissioning plan.	N/A

ER Section 10.2.1.2, Hydrology and Water Use. This section is revised to describe the cooling system as the Combination Wet and Dry Cooling Tower system. The 1st paragraph of ER Section 10.2.1.2 will be revised to read as follows:

Unit 3 would use a combination wet and dry cooling tower system for plant cooling, whereas Unit 4 would use a dry tower system. Make-up water for the wet cooling towers of Unit 3 would be taken from the North Anna Reservoir, consistent with the original permitting of the NAPS site. The amount of make-up water that is not returned as blowdown to the WHTF would be that evaporated in the wet towers, which is a small fraction of the amount of water in the lake. The evaporated water would be replaced by in-flowing water upstream of the dam. Once the site is decommissioned, the balance of water in the lake would be governed by the in-flowing water, evaporation from the surface of the lake, and the amount of water flowing over the dam.

Groundwater from existing wells would be sufficient for the potable water demands during operation of the new units.

ER Section 10.2.1.6, Atmospheric Releases and Meteorological Changes. This section is revised to describe the cooling system as the Combination Wet and Dry Cooling Tower system. ER Section 10.2.1.6 will be revised to read as follows:

There would be no major releases of pollutants to the atmosphere from operation of the new units, because only the testing of emergency generators and occasional use of large pieces of equipment that run on diesel fuel would generate such pollutants. The operation of a combination wet and dry tower system has the potential for making micro-level changes to the meteorology, but only in the immediate vicinity of the tower. Upon decommissioning of the new units, these changes would cease to be a factor. Therefore, the operation of ancillary equipment associated with the new units would not result in irreversible atmospheric or long-term meteorological changes to the area.

ER Section 10.3.2, Operation of the New Units and Long-Term Productivity. This section is revised to describe the cooling system as the Combination Wet and Dry Cooling Tower system. The 3rd and 4th paragraphs of ER Section 10.3.2 will be revised to read as follows:

The type of reactor to be installed at the ESP site has not yet been selected, nor has the ancillary equipment related to the reactor. Unit 3 would use a combination wet and dry cooling tower system, whereas Unit 4 would use a dry tower system. Make-up water for Unit 3 would be taken from the North Anna Reservoir, consistent with the original permitting of the NAPS site. The amount of water that is not returned as blowdown to the WHTF would be that evaporated in the wet towers, which is a small fraction of the amount of water in the lake. The evaporated water would be replaced by in-flowing water upstream of the dam. Once the site is decommissioned, the balance of water in the lake would be governed by the in-flowing water, evaporation from the surface of the lake, and the amount of water flowing over the dam. There would be no future long-term issues with regard to future uses of the ESP site.

The blowdown water discharge from Unit 3 would be to the existing WHTF. Although there would be a small increase in water temperature within the WHTF, there would be no thermal impact within the North Anna Reservoir part of Lake Anna that is open to the public for recreational purposes. Additionally, the discharges to the existing WHTF are projected to remain within the limits of the wastewater discharge permit issued for the NAPS site (or, if needed, to the wastewater discharge permit as amended). Therefore, any long-term effects on the future usage of the lake, including the cessation of the heated discharge, would be small.