Appendix E
Applicant's Environmental Report – Operating License Renewal Stage
North Anna Power Station Units 1 and 2
Virginia Electric & Power Company
License Nos. NPF-4 and NPF-7

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ACRONYMS AND ABBREVIATIONS

AQCR Air Quality Control Region
Btu British thermal unit
CCW component cooling water
CEQ Council on Environmental Quality
CFR Code of Federal Regulations
cfs cubic feet per second
CWA Clean Water Act
DSM demand-side management
EPA (U.S.) Environmental Protection Agency
ºF degrees Farenheit
FWS (U.S.) Fish and Wildlife Service
GEIS Generic Environmental Impact Statement
gpm gallons per minute
GWH gigawatt hours
IPA integrated plant assessment
IPE Individual Plant Examination
IPEEE Individual Plant Examination - External Events
IRP Integrated Resource Plan
kV kilovolt
kWh kilowatt hour
LOCA loss of coolant accident
LOS level of service
MACCS2 Melcor Accident Consequence Code System
MOX mixed oxide (fuel)
msl mean sea level
MW megawatt
MWe megawatt-electric
MWt megawatt-thermal

NA Not applicable
NAPS North Anna Power Station
NEPA National Environmental Policy Act
NESC® National Electrical Safety Code®
NMFS National Marine Fisheries Service
NPDES National Pollutant Discharge Elimination System
NRC (U.S.) Nuclear Regulatory Commission
PM particulate matter
PRA probabilistic risk assessment
psig pounds per square inch gage
PWR pressurized water reactor
RCP reactor coolant pump
SAMA Severe Accident Mitigation Alternative
SAMDA Severe Accident Mitigation Design Alternative
SHPO State Historic Preservation Officer
SMITTR surveillance, monitoring, inspection, testing, trending, and recordkeeping
SPS Surry Power Station Units 1 and 2
SSCs structures, systems, and components
USC United States Code
VDCR Virginia Department of Conservation and Recreation
VDEQ Virginia Department of Environmental Quality
VPDES Virginia Pollutant Discharge Elimination System
WHTF Waste Heat Treatment Facility

1.0 INTRODUCTION

1.1 Purpose and Need for the Proposed Action

The U.S. Nuclear Regulatory Commission (NRC) licenses the operation of domestic nuclear power reactors in accordance with the Atomic Energy Act of 1954 and NRC implementing regulations. Dominion Generation (Dominion) operates North Anna Power Station Units 1 & 2 (NAPS) pursuant to NRC operating licenses NPF-4 and NPF-7, respectively. Ownership of the station is shared by Dominion Resources, Inc. and the Old Dominion Electric Cooperative (ODEC). ODEC is a partial financial owner of the facility and will not operate the facility. The Unit 1 license will expire April 1, 2018, and the Unit 2 license will expire August 21, 2020. Dominion has prepared this environmental report in conjunction with its application to NRC to renew the operating licenses for North Anna Units 1 & 2, as provided by the following NRC regulations:

- Title 10, Energy, Code of Federal Regulations (CFR), Part 54, Requirements for Renewal of Operating Licenses for Nuclear Power Plants, Section 54.23, Contents of Application-Environmental Information (10 CFR 54.23) and
- Title 10, Energy, CFR, Part 51, Environmental Protection Requirements for Domestic Licensing and Regulatory Functions, Section 51.53, Post-Construction Environmental Reports, Subsection 51.53(c), Operating License Renewal Stage [10 CFR 51.53(c)].

NRC has defined the purpose and need for the proposed action, the renewal of the operating licenses for nuclear power plants such as NAPS, as follows:

The purpose and need for the proposed action (renewal of an operating license) is to provide an option that allows for power generation capability beyond the term of a current nuclear power plant operating license to meet future system generating needs, as such needs may be determined by state, utility, and where authorized, federal (other than NRC) decision makers. (Ref. 1.1-1, pp. 28467 - 28497)

The renewed operating licenses would permit 20 additional years of plant operation, beyond the current NAPS licensed operating period of 40 years.

1.2 Environmental Report Scope and Methodology

NRC regulations for domestic licensing of nuclear power plants require environmental review of applications to renew operating licenses. The NRC regulation 10 CFR 51.53(c) requires that an applicant for license renewal submit with its application a separate document entitled *Applicant's Environmental Report - Operating License Renewal Stage*. In determining
necessary information to include in the NAPS Environmental Report, Dominion has relied on NRC regulations and the following supporting documents that provide additional insight into the regulatory requirements.

- NRC supplementary information in the *Federal Register* (Refs. 1.1-1, pp. 28467 - 28497;
1.2-1, pp. 39555 - 39556; 1.2-2, pp. 66537 - 66554; and 1.2-3, pp. 48496 - 48507)
- *Generic Environmental Impact Statement for License Renewal of Nuclear Plants* (GEIS)
(Refs. 1.2-4 and 1.2-5)
- *Regulatory Analysis for Amendments to Regulations for the Environmental Review for
Renewal of Nuclear Power Plant Operating Licenses* (Ref. 1.2-6)
- *Public Comments on the Proposed 10 CFR Part 51 Rule for Renewal of Nuclear Power
Plant Operating Licenses and Supporting Documents: Review of Concerns and NRC Staff
Response* (Ref. 1.2-7)

Dominion has prepared Table 1-1 to verify conformance with regulatory requirements. Table 1-1 indicates each section in which the environmental report responds to each requirement of 10 CFR 51.53(c). In addition, each responsive section in the report is prefaced by a boxed quote of the regulatory language and applicable supporting document language.

The environmental report comprises nine chapters. This Chapter describes the purpose and need for the proposed action, renewal of NAPS operating licenses. Chapter 2 describes the environs affected by NAPS operations and Chapter 3 describes pertinent aspects of the plant and its associated infrastructure. Chapter 4 provides results of the analyses of impacts on the environment from NAPS license renewal. Chapter 5 describes the process Dominion used to identify any new and significant information regarding environmental impacts. Chapter 6 summarizes the impacts of license renewal and mitigating actions. Chapter 7 describes feasible alternatives to the proposed action and their environmental impacts. Chapter 8 compares the impacts of license renewal with those alternatives. Chapter 9 discusses NAPS compliance with regulatory requirements.

Table 1-1
Environmental Report Responses to License Renewal Environmental Regulatory Requirements

Regulatory Requirement	Responsive Environmental Report Section(s)
10 CFR 51.53(c)(1)	Entire Document
10 CFR 51.53(c)(2), Sentences 1 and 2	3.0 Proposed Action
10 CFR 51.53(c)(2), Sentence 3	7.2.2 Environmental Impacts of Alternatives
10 CFR 51.53(c)(2) and 10 CFR 51.45(b)(1)	4.0 Environmental Consequences of the Proposed Action and Mitigating Actions
10 CFR 51.53(c)(2) and 10 CFR 51.45(b)(2)	6.3 Unavoidable Adverse Impacts
10 CFR 51.53(c)(2) and 10 CFR 51.45(b)(3)	7.0 Alternatives to the Proposed Action 8.0 Comparison of Environmental Impacts of License Renewal with the Alternatives
10 CFR 51.53(c)(2) and 10 CFR 51.45(b)(4)	6.5 Short-term Use Versus Long-term Productivity of the Environment
10 CFR 51.53(c)(2) and 10 CFR 51.45(b)(5)	6.4 Irreversible and Irretrievable Resource Commitments
10 CFR 51.53(c)(2) and 10 CFR 51.45(c)	4.0 Environmental Consequences of the Proposed Action and Mitigating Actions 6.2 Mitigation 7.2.2 Environmental Impacts of Alternatives 8.0 Comparison of Environmental Impacts of License Renewal with the Alternatives
10 CFR 51.53(c)(2) and 10 CFR 51.45(d)	9.0 Status of Compliance
10 CFR 51.53(c)(2) and 10 CFR 51.45(e)	4.0 Environmental Consequences of the Proposed Action and Mitigating Actions 6.3 Unavoidable Adverse Impacts
10 CFR 51.53(c)(3)(ii)(A)	4.1 Water Use Conflicts (Plants with Cooling Ponds or Cooling Towers Using Make-Up Water from a Small River with Low Flow) 4.6 Groundwater Use Conflicts (Plants Using Cooling Towers Withdrawing Make-Up Water from a Small River)

Table 1-1 (continued)
Environmental Report Responses to License Renewal Environmental Regulatory Requirements

Regulatory Requirement	Responsive Environmental Report Section(s)	
10 CFR 51.53(c)(3)(ii)(B)	4.2	Entrainment of Fish and Shellfish in Early Life Stages
	4.3	Impingement of Fish and Shellfish
	4.4	Heat Shock
10 CFR 51.53(c)(3)(ii)(C)	4.5	Groundwater Use Conflicts (Plants Using > 100 gpm of Groundwater)
	4.7	Groundwater Use Conflicts (Plants Using Ranney Wells)
10 CFR 51.53(c)(3)(ii)(D)	4.8	Degradation of Groundwater Quality
10 CFR 51.53(c)(3)(ii)(E)	4.9	Impacts of Refurbishment on Terrestrial Resources
	4.10	Threatened or Endangered Species
10 CFR 51.53(c)(3)(ii)(F)	4.11	Air Quality During Refurbishment (Non-Attainment or Maintenance Areas)
10 CFR 51.53(c)(3)(ii)(G)	4.12	Impact of Microbiological Organisms on Public Health
10 CFR 51.53(c)(3)(ii)(H)	4.13	Electric Shock from Transmission-Line-Induced Currents
10 CFR 51.53(c)(3)(ii)(I)	4.14	Housing Impacts
	4.15	Public Utilities: Public Water Supply Availability
	4.16	Education Impacts from Refurbishment
	4.17	Offsite Land Use
10 CFR 51.53(c)(3)(ii)(J)	4.18	Transportation
10 CFR 51.53(c)(3)(ii)(K)	4.19	Historic and Archaeological Resources
10 CFR 51.53(c)(3)(ii)(L)	4.20	Severe Accident Mitigation Alternatives
10 CFR 51.53(c)(3)(iii)	4.0	Environmental Consequences of the Proposed Action and Mitigating Actions
	6.2	Mitigation
10 CFR 51.53(c)(3)(iv)	5.0	Assessment of New and Significant Information
10 CFR 51, Appendix B, Table B-1, Footnote 6	2.11	Minority and Low-Income Populations

1.3 References

Ref. 1.1-1 U.S. Nuclear Regulatory Commission. 1996. "Environmental Review for Renewal of Nuclear Power Plant Operating Licenses." *Federal Register*. 61, No. 109. June 5.

Ref. 1.2-1 U.S. Nuclear Regulatory Commission. 1996. "Environmental Review for Renewal of Nuclear Power Plant Operating Licenses; Correction." *Federal Register*. 61, No. 147. July 30.

Ref. 1.2-2 U.S. Nuclear Regulatory Commission. 1996. "Environmental Review for Renewal of Nuclear Power Plant Operating Licenses." *Federal Register*. 61, No. 244. December 18.

Ref. 1.2-3 U.S. Nuclear Regulatory Commission. 1999. "Changes to Requirements for Environmental Review for Renewal of Nuclear Power Plant Operating Licenses; Final Rules." *Federal Register*. 64, No. 171. September 3.

Ref. 1.2-4 U.S. Nuclear Regulatory Commission. 1996. *Generic Environmental Impact Statement for License Renewal of Nuclear Plants (GEIS)*. Volumes 1 and 2. NUREG-1437. Washington, DC.

Ref. 1.2-5 U.S. Nuclear Regulatory Commission. 1999. G*eneric Environmental Impact Statement for License Renewal of Nuclear Plants (GEIS).* Section 6.3, "Transportation", and Table 9-1, "Summary of findings on NEPA issues for license renewal of nuclear power plants." NUREG-1437. Volume 1. Addendum 1. Washington, DC.

Ref. 1.2-6 U.S. Nuclear Regulatory Commission. 1996. *Regulatory Analysis for Amendments to Regulations for the Environmental Review for Renewal of Nuclear Power Plant Operating Licenses*. NUREG-1440. Washington, DC.

Ref. 1.2-7 U.S. Nuclear Regulatory Commission. 1996. *Public Comments on the Proposed 10 CFR Part 51 Rule for Renewal of Nuclear Power Plant Operating Licenses and Supporting Documents: Review of Concerns and NRC Staff Response*. Volumes 1 and 2. NUREG-1529. Washington, DC.

2.0 SITE AND ENVIRONMENTAL INTERFACES

2.1 Location and Features

North Anna Power Station Units 1 and 2 (NAPS) are located in Louisa County in northeastern Virginia on a peninsula on the southern shore of Lake Anna, which is at the end of State Route 700 (Figure 2-1; Ref. 2.1-1). The location is latitude 38° 3' 36" North and 77° 47' 23" West (Unit 1) and latitude 38° 3' 38" North and 77° 47' 26" West (Unit 2). Regionally, NAPS is approximately 40 miles nor th-northwest of Richmond, Virginia; 36 miles east of Charlottesville, Virginia; and 22 miles southwest of Fredericksburg, Virginia. Interstate 95 passes within 16 miles of the NAPS and Interstate 64 passes within 18 miles of the site (see Figure 2-2).

The largest community within 10 miles of the site is the Town of Mineral, Virginia, located in Louisa County. Mineral is about six miles west-southwest of NAPS and had a population of 452 in 1990 (Figure 2-2; Ref. 2.1-1). The Town of Louisa is about 12 miles west of the site. Lake Anna State Park lies five miles northwest of NAPS and provides facilities for picnicking, fishing, boat launching, swimming, and biking. The NAPS site and exclusion area (within a 5,000-foot radius of the reactors) consist of approximately 1,043 acres of land and about 760 acres covered by the waters of Lake Anna and the Waste Heat Treatment Facility (WHTF), a recognized treatment facility by the Commonwealth of Virginia. See Section 3.1 for greater detail.

NAPS is situated approximately five miles upstream from the North Anna Dam, at a minimum elevation of 271 feet above mean sea level (msl), and is laid out according to the site plan shown in Figure 2-3 and described in Ref. 2.1-1. In addition to the two nuclear reactors, their turbine building, intake structure, discharge canal, and auxiliary buildings, the site also contains the North Anna Nuclear Information Center (i.e., visitor center).
Dominion owns and controls all the land within the site boundary (exclusion area), both above and beneath the water surfaces and including those portions of Lake Anna and the WHTF that lie within the site boundary (Ref. 2.1-1). Dominion also owns all land outside the site boundary that forms Lake Anna and the WHTF, up to their expected high-water marks (elevation 255 ft above msl). Dominion purchased a total of 18,643 acres of rural land (about 80 percent forested) for the development of the NAPS, as well as all supporting facilities,

[picture not included] Lake Anna State Park

including: Lake Anna; the WHTF; earthen dams; dikes; railroad spur; and roads, bridges, and miscellaneous structures and facilities.

The aquatic resources of Lake Anna are managed cooperatively by Dominion and state natural resource agencies, including the Virginia Department of Game & Inland Fisheries and the Virginia Department of Conservation and Recreation. The Virginia Department of Game & Inland Fisheries has been actively involved in managing Lake Anna's fish communities since the lake filled in 1972. Section 2.2 contains additional information on fisheries management activities at Lake Anna, including fish stocking and fish habitat enhancement, as well as information about the WHTF and the North Anna River ecosystem.
The topography in the region of the NAPS is characteristic of the central Piedmont Plateau of Virginia, with a gently undulating surface varying from 200 to 500 feet above sea level. The surrounding region is covered with forest and cut-over second growth timber, interspersed with an occasional farm. The land adjacent to Lake Anna is becoming increasingly residential as it is developed (Ref. 2.1-1). Section 3.1 describes key features of NAPS, including reactors, containment, cooling water systems, groundwater usage, and transmission systems.

[picture not included] Lake Anna

2.2 Aquatic and Riparian Ecological Communities

[picture not included] North Anna Drainage System

The North Anna River rises in Louisa and Orange Counties and flows east for about 60 miles before joining the South Anna River to form the Pamunkey River (Figure 2-2). The Pamunkey River flows to the southeast, joining with the Mattaponi River to form the York River, which flows into the Chesapeake Bay north of the Hampton Roads area of Virginia. The North Anna River drains an area of approximately 600 square miles (Ref. 2.2-1).

Lake Anna, built to supply cooling water for NAPS, was created by erecting a dam in 1971 on the main stem of the North Anna River, just upstream of the confluence of the North Anna River and Northeast Creek (Figure 2-1). Lake Anna drains an area of 343 square miles (Ref. 2.2-3). The dam is approximately 90 feet high and 5,000 feet wide, and contains 900,000 cubic yards of earth and rock (Ref. 2.2-1). Lake Anna began filling in January 1972 and reached full pool in December of that year (Ref. 2.2-1).

Lake Anna is approximately 17 miles long, with 272 miles of shoreline. It is relatively shallow (maximum depth, 90 feet; average depth, approximately 25 feet at full pool), with a surface area of 9,600 acres (Ref. 2.2-1). The normal elevation of the reservoir is 250 feet above msl, at which stage it holds 305,000 acre-feet of water (Ref. 2.2-1). The Commonwealth of Virginia requires a 40-cubic-foot-per-second (cfs) minimum discharge of water from the North Anna Dam except under drought conditions. These minimum flow requirements are established to maintain instream flows and water quality in the North Anna River below the
North Anna River 1/4 mile below North Anna Dam

dam and in the Pamunkey and York Rivers, which are further downstream (see Figure 2-2). Should drought conditions occur and Lake Anna surface water levels fall to 248 feet above msl, Dominion will begin reducing releases below the 40 cfs level in accordance with the Lake Level Contingency Plan as stipulated in Part I.F of the VPDES Permit (Ref. 2.2-2).

Prior to impoundment, water quality in the North Anna River was degraded by sedimentation and acid mine drainage from Contrary Creek, an 8.5-mile-long tributary that flowed into the river from the west, near the town of Mineral, Virginia (Figure 2-1). Land adjacent to Contrary Creek had been the site of extensive iron pyrite mining operations during the late 19th and early 20th centuries (Ref. 2.2-3). When the mine was abandoned (circa 1920), mine shafts and tailings piles were left exposed to the weather. Runoff from the mine area was acidic, with high concentrations of metals. Virtually no aquatic life was found in Contrary Creek downstream of the mine site (Ref. 2.2-1).

Also prior to impoundment, the density and diversity of fish and benthic macroinvertebrates had been markedly reduced in the North Anna River immediately downstream of its confluence with Contrary Creek. More subtle changes were evident as far as 15 miles downstream, although water quality was generally satisfactory (Ref. 2.2-3).

In 1976, the Virginia State Water Control Board, in association with the U.S. Environmental Protection Agency (EPA), attempted to reclaim previously-mined and disturbed areas along Contrary Creek to reduce the impacts of sedimentation and acid mine drainage (Ref. 2.2-3). Heavy equipment was used to level and regrade tailings piles and establish contours that would reduce erosion. Re-contoured areas were limed and fertilized to encourage plant growth, then seeded with grasses to stabilize surface soils. The reclamation project reduced, to some extent, erosion and sedimentation in the area.

The creation of Lake Anna mitigated other water quality impacts from Contrary Creek area runoff. Low-pH creek water is neutralized as it mixes with higher-pH reservoir water. Heavy metals are removed from the water column by adsorption to clay par ticles and the subsequent settling of these particles. Chemical precipitation (and co-precipitation with iron) may also remove zinc and copper ions from Contrary Creek water when it mixes with Lake Anna water.

A comprehensive study of Lake Anna's water quality and aquatic communities was conducted in support of a Clean Water Act Section 316(a) Demonstration for NAPS (Ref. 2.2-3). This evaluation was based on five years (1973-1977) of pre-operational studies and eight years (1978-1985) of operational studies. Water quality, water temperature, and biological monitoring were conducted in upper, middle, and lower portions of the reservoir, and in the North Anna River below the reservoir.

Water quality in Lake Anna has historically been good to excellent. Turbidity levels are generally low, except during periods of heavy inflows from tributary streams. No untreated wastes from upstream municipalities or industrial facilities enter the reservoir. As discussed in Section 4.17.2 (Offsite Land Use-License Renewal Term), there has been considerable lakeshore development over the last two decades. By 1985, about 1,000 primary residences and vacation houses had been developed, but there were no indications of eutrophication or water quality degradation in the reservoir (Ref. 2.2-3).

Nutrient levels (nitrates and phosphates) from flooded farmland were elevated in the years following impoundment of the river and its valley, but stabilized in the 1980s at low levels sufficient to support a thriving community of benthic macroinvertebrates, plankton, and fish. As noted previously, there have been no indications of nutrient enrichment or eutrophication in Lake Anna, beyond those associated with normal reservoir aging. Lake Anna and the North Anna River are not among the waterbodies designated as "nutrient-enriched waters" by the Virginia State Water Control Board (Ref. 2.2-4, pg. 2908).

Since its creation, Lake Anna has developed into a reservoir with three distinct ecological zones: Upper Lake, Mid-Lake, and Lower Lake. The Upper Lake is essentially riverine, shallow (average depth of 13 feet), and shows some evidence of stratification in summer. The Mid-Lake is deeper and stratifies in summer. It receives waters from Contrary Creek that, because of years of mining in its floodplain, are sometimes low in pH and high in metals. As noted earlier in this section, creation of Lake Anna has reduced the impacts of acid mine drainage on the North Anna River. The Lower Lake is deeper (average depth of 36 feet), clearer (with more light penetration), and shows pronounced annual patterns of winter mixing and summer stratification. The epilimnion (warm layer above the thermocline) was generally eight feet deep during pre-operational years, and 26 to 33 feet deep during operational years. The increase in depth of the epilimnion appears to be related to the heated discharge entering the reservoir from Dike 3 (see Figure 3-2) and the withdrawal of cooler, deeper water at the NAPS intake (Ref. 2.2-3). The heated discharge (and attendant mixing) and withdrawal have also increased the depth of oxygenation, with the layer of water holding at least 5 milligrams per liter of dissolved oxygen increasing from 5 meters (pre-operational) to 9 meters (operational).

NAPS has a once-through cooling system that withdraws water from the Mid-Lake area and discharges it into a discharge canal (see Section 3.1.2 for details on the system). The discharge canal is approximately 3,600 feet long and discharges into the WHTF, which was formed by diking off a portion of Lake Anna. The cooling water residence time in the WHTF is approximately 14 days, depending on condenser flow rate. More than half the station’s waste heat is dissipated in the WHTF. The only discharge from the WHTF into Lake Anna is at Dike 3, which is in the lower portion of the reservoir near the dam. The discharge is a

submerged, high-velocity jet that promotes rapid mixing with reservoir waters (see Figure 2-4).

Results of Lake Anna temperature monitoring indicate that the shallower Upper Lake warms earlier in spring and reaches maximum temperature in summer sooner than the Lower Lake. The Lower Lake, with its greater depth and volume, warms more slowly in spring and retains its heat later in the year. It is estimated that the heat contributed by NAPS corresponds to about 10 percent of the solar heat that enters the reservoir on summer days (Ref. 2.2-3). Dominion began monitoring Lake Anna water temperatures in 1973 Ref. 2.2-3), but made sufficient study plan changes in 1975 that pre- and post-1975 data are not directly comparable. Dominion monitored water temperatures at seven Lake Anna stations from 1975 through 1985 as part of a Clean Water Act Section 316(a) Demonstration for NAPS (Ref. 2.2-3, Section 3.5, Table 3.5-2). Temperatures were recorded hourly at most of these locations. Highest (hourly average) temperatures recorded in June, July, and August over this period were 91.8ºF (at an Upper Lake station in 1984), 92.7ºF (at an Upper Lake station in 1977), and 91.6ºF (at a Lower Lake station in 1980). The highest (hourly average) water temperature was measured on July 19, 1977, at the northern-most station (Pamunkey Creek arm), before NAPS began operating. The highest (hourly average) water temperature measured in an operational year was 92.3ºF, recorded in July 1983 (Ref. 2.2-3, Section 3.5, pg. 74).

In recent years, Dominion has continued to monitor Lake Anna water temperatures, using fixed temperature recorders at seven stations, ranging from the Pamunkey Creek arm of the Upper Lake to the North Anna Dam (Figure 2-1). This temperature monitoring is part of a larger post-316(a) Demonstration environmental monitoring effor t that includes fish population studies. Temperatures in Lake Anna are reported as monthly means of daily high, mean, and low temperatures, to permit direct comparisons with historical data. The range of temperatures and between-station temperature trends recorded over a recent six-year period (1994-1999) showed striking similarities to historical data (Refs. 2.2-5; 2.2-6; 2.2-7; 2.2-8; 2.2-9; and 2.2-10). These temperature data do not indicate an overall long-term warming trend in the reservoir. Further, differences in temperature between lake "regions" continue to be small, regardless of time of year and station operating levels. Dominion's Environmental Policy & Compliance-Environmental Biology group submits annual reports to the Virginia Department of Environmental Quality on water temperatures and fisheries monitoring in Lake Anna and the Lower North Anna River.

Biological Communities of Lake Anna

Phytoplankton abundance gradually increased in the years following impoundment (in concert with nutrient levels), declined in 1978, and increased slowly through 1985. This is a

typical successional pattern in newly-created reservoirs, which often take 5 to 10 years to reach biological stability or equilibrium (Ref. 2.2-3). Approximately 55 phytoplankton genera were identified during pre-operational years, while 77 genera were identified during operational years. Phytoplankton were more abundant in the Upper Lake, corresponding with higher nutrient levels and more available habitat.

Dominant forms were diatoms, green algae, blue-green algae (cyanobacteria), and cryptomonads. Phytoplankton community structure was similar to that observed in other Piedmont reservoirs. No nuisance algae blooms were observed during the Section 316(a) monitoring.

With the possible exception of some isolated instances, when *Microcystis* (a blue-green form)
colonies were visible as a film on the surface of small portions of Lake Anna, no nuisance algae blooms have been observed since 1986, when the Section 316(a) Demonstration was completed. Dominion environmental staff have received no complaints from recreational users of Lake Anna about *Microcystis* and are unaware of any water quality problems caused
by these algae.

The zooplankton community achieved stability around 1975; thereafter, densities and diversity measures remained fairly constant. The Upper Lake supported more abundant and diverse zooplankton assemblages than the Mid- and Lower-Lake areas. Differences between Upper and Lower-Lake areas were attributed to greater availability of phytoplankton and other food and habitat differences.

Zooplankton showed spring and summer peaks in abundance, similar to zooplankton communities in other southeastern reservoirs. Rotifers dominated collections in both pre-operational and operational years. Three small-bodied zooplankton genera: *Polyarthra* (a
common rotifer with feather-like "wings"); *Keratella* (a common rotifer with a shell and spines);
and *Bosmina* (a small, very-common cladoceran) were particularly abundant. Reservoirs like Lake Anna with healthy populations of "landlocked" small shad and herring (Lake Anna has both threadfin shad (*Dorosoma petenense*) and blueback herring (*Alosa aestivalis*)), are
often dominated by small-bodied zooplankters (rotifers and copepods), because larger-bodied forms are selectively preyed upon by schooling clupeids (Ref. 2.2-11). No unusual or nuisance zooplankton populations were observed in Lake Anna.

The benthic community of Lake Anna showed several distinct post-impoundment changes. In early years (1972-1976), there was a shift from riverine to lacustrine species. There were changes in community composition as well, with 111 taxa identified in pre-operational years and 124 taxa identified in operational years, 60 of which had not been seen previously. These changes were observed throughout the reservoir and were presumed to be related to the shift from riverine to reservoir conditions, rather than to power plant operation. A more

striking change, also unrelated to plant operation, was the appearance and subsequent sharp increase in densities from 1979-1981 of the non-native Asiatic clam, *Corbicula fluminea*. The *Corbicula* population in Lake Anna has stabilized in more recent years. Because of the importance of recreational fishing in Lake Anna, its fish community has been the subject of wide-ranging studies. Abundance and distribution of fish were evaluated, using a variety of sampling methods over a period from 1975-1985 to ensure that gear selectivity did not bias results. Larval fish studies, creel surveys, and a number of special studies were also conducted and focused on the reproduction and growth of important species, such as largemouth bass (*Micropterus salmoides)*. Finally, striped bass (*Morone saxatilis*) seasonal
movement and habitat preferences were investigated, using ultrasonic tags.

From 1975 through 1985, 39 species of fish (representing 12 families) were found in Lake Anna (Ref. 2.2-3). Species included those historically found in the North Anna River, those that had been in local farm ponds inundated by the new reservoir, and nine species (four non-native) introduced by the Virginia Department of Game & Inland Fisheries.
The community structure remained relatively stable over the 1975-1985 period, with some year-to-year variation in species composition caused by: (1) normal population fluctuations; (2) reservoir aging; (3) the introduction of forage species and competing predators; (4) the installation of fish attractors and artificial habitat; and (5) the increase in *Corbicula* densities. Post-1975 changes included: (1) a decline in relative abundance of yellow perch (*Perca flavescens*) and black crappie (*Promoxis nigromaculatus)*; (2) an increase in relative abundance of white perch (*Morone americana*) and threadfin shad; and (3) an increase in redear sunfish (*Lepomis microlophus)* abundance, with a corresponding decrease in pumpkinseed (*Lepomis gibbosus*). None of these changes appeared to be related to NAPS operation.

The mean standing crop ranged between 232 and 296 pounds per acre from 1975 to 1984, and increased substantially in 1985 (to 417 pounds per acre), because of a large increase in introduced threadfin shad and an increase in the abundance of gizzard shad (*Dorosoma cepedianum*). Both species provide forage for Lake Anna's game fish, which include largemouth bass, walleye (*Stizostedion vitreum*), and striped bass. Lake Anna appears to support a higher standing crop of fish than most U.S. reservoirs, with thriving populations of several forage species and higher-trophic-level (gamefish) species.
Standing stocks of largemouth bass, Lake Anna's most popular sport fish, remained stable over the 1975-1985 period. In 1985, Lake Anna produced more largemouth bass of "citation" size (eight pounds or more) than any other lake or reservoir in Virginia. Life history studies of Lake Anna largemouth bass, summarized in the 316(a) Demonstration, suggest that the

reproductive success, feeding ecology, and growth of this species were similar in pre-operational and operational years.

Four non-native fish species (striped bass, walleye, threadfin shad, and blueback herring) have been stocked in Lake Anna by the Virginia Department of Game & Inland Fisheries since 1972. Striped bass were introduced in 1973, and have been stocked annually since 1975. They provide a "put-grow-and-take" fishery; streams, including the North Anna River, that flow into Lake Anna lack the flow, depth, and length to support striped bass spawning runs. Studies show that striped bass grow and provide a substantial recreational fishery in Lake Anna, but adults are subject to late-summer habitat restrictions (limited to cooler-water refuge areas) and growth limitations. Walleye are also stocked annually by the Virginia Department of Game & Inland Fisheries and are highly sought-after game fish.

Threadfin shad were introduced in 1983 to provide additional forage for striped bass and other top-of-the-food-chain predators. This species is vulnerable to cold shock and winter kills, and would not be able to survive in Lake Anna if it were not for NAPS operation. Threadfin shad appear to be thriving in Lake Anna and are an important source of food for game fish. Blueback herring, fish stocked by the Virginia Department of Game & Inland Fisheries in 1980 as a forage species, have not been as successful.

A fifth non-native species, the herbivorous grass carp, was stocked by Dominion (with the approval of the Virginia Department of Game & Inland Fisheries) in the WHTF in 1994 to control growth of the nuisance submersed aquatic plant hydrilla (*Hydrilla verticillata)*. Sterile
triploid (meaning they have an extra set of chromosomes) grass carp are widely used in the southeastern U.S. as biological controllers of undesirable fast-spreading aquatic plants, such as hydrilla and Brazilian elodea. The Virginia Department of Game & Inland Fisheries requires pond owners and lake managers to obtain special permits prior to importing or stocking grass carp, to ensure that the fish are sterile and that the waters being stocked are suitable for grass carp.

In addition to the previously described stocking programs, which are designed to expand fishing opportunities in Lake Anna, the Virginia Department of Game & Inland Fisheries (in cooperation with Dominion, Lake Anna State Park, and local fishing clubs) placed 20 underwater fish structures in the reservoir over the 1983-1990 period to provide additional fish habitat in areas with "clean" bottoms (Ref. 2.2-12). The structures, consisting of conically-shaped piles of cinder blocks, small trees, and brush (secured to the blocks), are intended to provide escape cover for young fish and spawning and feeding areas for larger fish. These fish structures were intended primarily to provide habitat for largemouth bass, black crappie, and sunfish (bluegill [*Lepomis macrochirus*] in particular), but benefit a variety
of fish species.

As noted previously in this section, Dominion has continued to monitor fish populations in Lake Anna since 1986, as part of a larger post-316(a) Demonstration environmental monitoring program. Fisheries monitoring over a recent six-year (1994-1999) period reveals a balanced reser vo i r f i s h community compr ised of heal thy populations o f top-of-the-food-chain predators (e.g., largemouth bass and striped bass) and the forage species on which they feed (e.g., threadfin shad and gizzard shad), panfish (e.g., bluegill, redear sunfish, redbreast (*Lepomis auritus*)), and catfish (channel catfish (*Ictalurus punctatus*) and white catfish (*Ameiurus catus*), in particular). Lake Anna is well known as a producer of trophy largemouth bass and large numbers of striped bass. In 1999, Lake Anna ranked third in the Commonwealth of Virginia in producing trophy certificate ("citation") largemouth bass (Ref. 2.2-10).

The Virginia Department of Game & Inland Fisheries website contains the following description of Lake Anna:

Department sampling data indicate that the largemouth bass population structure has increased gradually over the past decade, and electrofishing catch rates of "preferred" bass (those over 15") were again high in 2000. Striped bass abundance was also very high in 1999 based on net surveys, and strong year-classes were present from 1997 and 1999. Anglers can expect the recent good striper and largemouth fishing to continue (Ref. 2.2-13).

North Anna River System

The North Anna River joins the South Anna River 23 miles downstream from the North Anna Dam, forming the Pamunkey River. Before 1972, when the river was impounded, flows varied considerably (1 to 24,000 cfs) from year to year and water quality was degraded by acid mine drainage from Contrary Creek. After 1972, fluctuations in flow were moderated (40 to 16,000 cfs from 1972 through 1985) and water quality was improved as a result of reclamation activities at the Contrary Creek mine site and the acid-neutralizing effect of Lake Anna's waters.

Water quality downstream from the North Anna Dam is strongly influenced by conditions in the reservoir and releases at the Dam. Water moving from Lake Anna to the North Anna River is less turbid and more chemically stable than the pre-impoundment flow. Dissolved oxygen levels are high (averaging 9.6 milligrams per liter over the 1981-1985 period) immediately downstream of the Dam and increase further downstream, presumably as a result of turbulent mixing (Ref. 2.2-3).

Summer water temperatures from 1970-1985 were higher near the Dam than downstream, reflecting temperatures in the reservoir. The highest water temperature recorded in

pre-operational years was 89.4°F in July 1977, at a station one kilometer below the North Anna Dam. The highest temperature recorded in operational years was slightly higher, 90.9°F, recorded in August 1983 at the same station.

The North Anna River periphyton community below the Dam was dominated by diatoms and was similar to that of other southeastern streams. The benthic macroinvertebrate community in the stretch of the river below the Dam was dominated by filter-feeding caddisflies that feed on seston (living and dead plankton, plus particulate matter) from Lake Anna. Farther downstream, macroinvertebrate communities show more diversity and are similar to those of the South Anna River, which served as a control.

In pre-impoundment surveys, the fish community of the North Anna River downstream from the Contrary Creek inflow was dominated by pollution-tolerant species. In the years following impoundment (and reclamation of the Contrary Creek mine site), there was a steady increase in measures of abundance and diversity (species richness) of fish. In 1984-85, 38 species from 10 families were found in the North Anna River, compared to 25 species from eight families in the control stream, the South Anna River. When reservoir species from Lake Anna were subtracted from the North Anna River totals, the two fish communities showed striking similarities, indicating that operation of NAPS has had little or no effect on fish populations downstream from the North Anna Dam.

Based on the 1999 Annual Report for Lake Anna and the North Anna River, the North Anna River downstream of the North Anna Dam has no major changes in the ecosystem (Ref. 2.2-10). A review of the data from the 1999 monitoring studies indicate that Lake Anna and the North Anna River continue to contain healthy, well-balanced ecological communities.

2.3 Groundwater Resources

As discussed in Sections 4.1, 4.5, 4.6 4.7, and 4.8, NAPS groundwater impact is not an issue. However, this section has been retained to maintain section heading conformity with the Surry Power Station Environmental Report, as an aid to regulatory review. The reader can refer to the NAPS Updated Final Safety Analysis Report (Ref. 2.1-1, Section 2.4.13) for site groundwater information.

2.4 Critical and Important Terrestrial Habitats

Much of the NAPS site consists of generation and maintenance facilities, laydown areas, parking lots, roads, and mowed grass. The only terrestrial community at the site consists of remnants of hardwood forests. Wildlife species found in the forested portions of NAPS are those typically found in upland forests of north-central Virginia.

Physical features (e.g., length, width, route) of each of the transmission lines associated with NAPS are described in Section 3.1.3. The transmission corridors are situated within the Piedmont physiographic province. Gently rolling hills with a few moderately steep ridges characterize this region. Transmission lines originating at NAPS traverse land-use categories typical of north-central Virginia, such as row crops, pasture, forests, and abandoned (old) fields. In addition, the transmission corridors pass through more natural habitat types, such as hardwood and pine-hardwood forests, bottomland hardwood forests, and shrub bogs. No areas designated by the U.S. Fish and Wildlife Service as "critical habitat" for endangered species exist at NAPS along or adjacent to associated transmission lines. In addition, the transmission corridors do not cross any state or federal parks, wildlife refuges, or wildlife management areas.

Except for unusual circumstances, transmission corridors are maintained on a three-year cycle. Mechanical mowing and selective herbicide application are the predominate methods for corridor maintenance. In areas where mowing is impractical or undesirable (e.g., densely

[picture not included] Dominion transmission lines

vegetated areas), handcutting and/or non-restricted use herbicides are used. Selective hand cutting is sometimes used in sensitive areas, such as wetlands. Locations of rare or sensitive plant species are marked on the cutting sketches (Ref. 2.4-1) that Dominion maintains for all its transmission lines. These cutting sketches, along with specifications regarding herbicide use and brush control, are provided to corridor maintenance contractors so that adverse impacts on rare and sensitive species and habitats can be avoided. Dominion allows landowners, hunting clubs, and conservation organizations to establish wildlife food plots and Christmas tree plantations under transmission lines. Dominion supports these efforts through cost-sharing. Numerous wildlife food plots are located along NAPS transmission lines.

[picture not included] Dominion transmission line corridor maintenance Dominion transmission line with Christmas tree plantation in background

2.5 Threatened or Endangered Species

Animal and plant species that are federally- or state-listed as endangered or threatened and that occur or could occur (based on habitat and known geographic range) in the vicinity of NAPS or along associated transmission lines are listed in Table 2-1.

Bald eagles (*Haliaeetus leucocephalus*), state and federally classified as threatened, are occasionally observed along Lake Anna. The bald eagle forages along coasts, rivers, and large lakes. Dominion is not aware of any eagle nests at NAPS or along the transmission lines. Loggerhead shrikes (*Lanius ludovicianus*), state-classified as threatened, have been observed in the vicinity of NAPS. Loggerhead shrikes inhabit agricultural lands and other open areas.

With the exception of the bald eagle and loggerhead shrike (*Lanius ludovicianus)*, terrestrial
species that are federally- and/or state-listed as endangered or threatened are not known to exist at NAPS or along the transmission lines. As of February 2000, there were no candidate federally threatened or endangered species that Dominion believes might occur at NAPS or along the transmission lines (Ref. 2.5-1). The species included in Table 2-1 were taken primarily from lists of species recorded by the Virginia Department of Conservation and Recreation's (VDCR's) Natural Heritage Program and the Virginia Department of Game & Inland Fisheries as occurring in the counties traversed by the transmission lines (Refs. 2.5-2; Ref. 2.5-5). Species with no recorded county occurrences were included in Table 2-1 if they could occur in the vicinity of NAPS or along associated transmission lines, based on habitat and known geographic range.

Some of the bird species shown in Table 2-1 would occur in north-central Virginia only during peak migration or seasonally (winter or summer). For example, migrant peregrine falcons (*Falco peregrinus*) traverse north-central Virginia and winter in coastal areas. Thus, peregrine falcons could possibly occur at NAPS or along the transmission lines during migration.

The small whorled pogonia (*Isotria medeoloides*) and swamp pink (*Helonias bullata*), two
plants that are federally-listed as threatened and state-listed as endangered, have been recorded in Caroline County (Ref. 2.5-2). The NAPS to Ladysmith transmission line (line 575) traverses a portion of Caroline County.

The transmission corridors are managed to prevent woody growth from reaching the transmission lines. The removal of woody species can provide outstanding grassland and bog-like habitat for many rare plant species that depend on open conditions. Dominion cooperates with VDCR's Natural Heritage Program in rare plant surveys within the transmission corridors, and annual reports on the rare plant species surveys are prepared by the Natural Heritage Program. Although several rare plant species have been located along

Dominion transmission corridors in other parts of the Commonwealth, no endangered or threatened plants have been recorded along the transmission corridors associated with NAPS.

Dominion and its contractors have monitored fish populations in Lake Anna and the North Anna River for 25 years, evaluating the response of these populations to NAPS operations. No federally- or state-listed fish species has been collected in any of these monitoring studies, nor has any listed species been observed in creel surveys or special studies conducted by Dominion biologists and affiliated researchers.

No federally-listed fish species' range includes the North Anna River and Lake Anna. One state-listed species, the emerald shiner (*Notropis atherinoides*), appears on a Final Environmental Statement list of fish collected in the North Anna River prior to its impoundment (Ref. 2.2-1, Appendix 2.14). However, according to several authoritative sources (Refs. 2.5-3, pp. 397-401, and 2.5-4, pp. 321-409), this species is known only from the Clinch and Powell Rivers in the extreme western part of the state. It appears that the fish was misidentified. The emerald shiner is often confused with the closely-related comely shiner (*Notropis amoenus*), which occurs throughout the York River drainage and has been documented from Lake Anna and the North Anna River (Ref. 2.5-3). The comely shiner was not listed in the Final Environmental Statement, but has been collected regularly by Dominion biologists in post-operational monitoring of the lower North Anna River (Ref. 2.2-8, Tables 4.2.2 and 4.2.3). The emerald shiner has not been collected in any of the post-operational surveys or monitoring studies.

Based on the Virginia Department of Game & Inland Fisheries' Fish and Wildlife Information Service database, as many as two state- and federally-listed freshwater mussel species could occur in streams in the vicinity of NAPS, or in streams crossed by NAPS transmission corridors (Table 2-1). It should be emphasized that neither of these species has actually been observed as occurring in streams in the vicinity of NAPS or in streams crossed by its transmission lines. They have, however, been collected from counties occupied by NAPS or its transmission corridors.

A third mussel species that has been reported as occurring in the vicinity of NAPS, the fluted kidneyshell mussel (*Ptychobranchus subtentum*), is a candidate for federal listing. The Virginia Department of Game & Inland Fisheries' Fish and Wildlife Information Service database lists this species occurring in a stream or streams in Louisa County. However, based on the fact that all other confirmed accounts of this species are confined to mountain streams in southwestern Virginia that are tributaries of the Tennessee River (which ultimately flows to the Gulf of Mexico), it is unlikely that a disjunct population would occur several hundred miles away in a river system that flows eastward to the Atlantic Ocean. Dominion

believes the reported occurrence of the fluted kidneyshell mussel in Louisa County may be inaccurate.

None of these mussel species was collected in pre-impoundment surveys of the North Anna River, and none has been collected in more recent years by Dominion biologists conducting routine monitoring surveys. Three bivalve species were collected in the North Anna basin prior to impoundment: *Elliptio complanatus*, *Elliptio productus*, and *Sphaerium striatum* (Ref. 2.2-1, Appendix 2.13). None of these is a special-status species. In more recent years, the introduced Asiatic clam (*Corbicula fluminea*) has dominated collections from both Lake Anna and the lower North Anna River. Small numbers of Unionids (*Elliptio* sp.) and fingernail clams (*Sphaeriidae*) have also been collected. Acid drainage and sediment from the Contrary Creek mine site (see Section 2.2 discussion) historically depressed mussel populations downstream from the Contrary Creek-North Anna River confluence but, in the 1980s, there were indications that mussel populations (*Elliptio* sp.) were recovering in the lower North Anna River (Ref. 2.2-3, Section 6.2).

2.6 Regional Demography

The *Generic Environmental Impact Statement for License Renewal of Nuclear Power Plants* (GEIS) presents a population characterization method that is based on two factors: "sparseness" and "proximity" (Ref. 2.6-1, Section C.1.4). "Sparseness" measures population density and city size within 20 miles of a site and categorizes the demographic information as follows.

Demographic Categories Based on Sparseness

	Category	
Most sparse	1.	Less than 40 persons per square mile and no community with 25,000 or more persons within 20 miles
	2.	40 to 60 persons per square mile and no community with 25,000 or more persons within 20 miles
	3.	60 to 120 persons per square mile or less than 60 persons per square mile with at least one community with 25,000 or more persons within 20 miles
Least sparse	4.	Greater than or equal to 120 persons per square mile within 20 miles

Source: Ref. 2.6-1, pg. C-159.

"Proximity" measures population density and city size within 50 miles and categorizes the demographic information as follows:

Demographic Categories Based on Proximity

	Category	
Not in close proximity	1.	No city with 100,000 or more persons and less than 50 persons per square mile within 50 miles
	2.	No city with 100,000 or more persons and between 50 and 190 persons per square mile within 50 miles
	3.	One or more cities with 100,000 or more persons and less than 190 persons per square mile within 50 miles
In close proximity	4.	Greater than or equal to 190 persons per square mile within 50 miles

Source: Ref. 2.6-1, pg. C-159.

The GEIS then uses the following matrix to rank the population category as low, medium, or high.

GEIS Sparseness and Proximity Matrix

Sparseness \ Proximity	1	2	3	4
1	1.1	1.2	1.3	1.4
2	2.1	2.2	2.3	2.4
3	3.1	3.2	3.3	3.4
4	4.1	4.2	4.3	4.4

Low Population Area

Medium Population Area

High Population Area

Source: Ref. 2.6-1, pg. C-6.

Dominion used 1990 census data from the U.S. Census Bureau website and geographic information system software (ArcView®) to determine demographic characteristics in the NAPS vicinity. The Census Bureau provides updated annual projections, in addition to decennial data, for selected portions of its demographic information. However, Section 2.11 (Minority and Low-Income Populations) of this environmental report uses 1990 minority and low-income population demographic information, because updated projections are not available by census tract. Dominion chose to also use 1990 data in this section, so that the data sets are consistent throughout the NAPS environmental report.

According to the Census Bureau information, 101,806 people live within 20 miles of NAPS, a population density of 81 persons per square mile. Applying the GEIS sparseness measures, NAPS falls into sparseness Category 3, having 60 to 120 persons per square mile within 20 miles.

An estimated 1,208,231 people live within 50 miles of NAPS. This equates to a population density of 154 persons per square mile within 50 miles. The city of Richmond, with a 1997 population of 193,700, is within the 50-mile radius. Applying the GEIS proximity measures, NAPS is Category 3, having fewer than 190 persons per square mile and one or more cities with 100,000 or more persons within 50 miles. According to the GEIS sparseness and

proximity matrix, the NAPS ranks of sparseness Category 3 and proximity Category 3 result in a population category of 3.3 and the conclusion that NAPS is located in a medium population area.

All or parts of 32 counties and 5 cities are located within 50 miles of NAPS. Figure 2-5 shows these locations. Of the counties, 31 are in Virginia and one is in Maryland. Approximately 73 percent of NAPS's employees live in four counties: Henrico, Louisa, Orange, and Spotsylvania (see Figure 2-5). The remaining 27 percent is distributed across 28 counties and 5 cities, with numbers ranging from 1 to 67 people.

Of the four counties in which the majority of NAPS employees reside, Spotsylvania and Louisa were ranked among the 20 fastest growing counties, with respect to population, in the Commonwealth of Virginia during the period from 1990 to 1998. These counties experienced 45.4 and 21.8 percent increases in population, respectively (Ref. 2.6-2). Henrico and Orange Counties had increases of 13.5 and 16.9 percent, respectively (Ref. 2.6-2).

Henrico is part of the Richmond-Petersburg metropolitan statistical area, with a 1997 population of 948,000 and an annual growth rate of 1.2 percent for the period from 1990 to 1998 (Ref. 2.6-2). Statewide, population growth is higher in Virginia's counties than in its cities, showing an overall trend of suburbanization. This trend is evident in the vicinity of NAPS. The Counties of Henrico, Louisa, Orange, and Spotsylvania have positive net migration rates: 8.6, 18.3, 15.4 and 36.6 percent, respectively, for the period from 1990 to 1998. The cities of Richmond and Charlottesville had negative net migration rates of -4.2 and -9.0, respectively, showing loss of population (Ref. 2.6-2). Table 2-2 shows estimated populations and annual growth rates for the four counties with the greatest potential to be affected by license renewal activities at NAPS. For the years 2000 and 2010, population projections for the four counties of interest were available from the Virginia Employment Commission. State-level projections out to 2025 were available from the U.S. Census Bureau. Although some projections from individual counties were available, the Virginia Employment Commission population projections were used for consistency in estimating a county-level growth rate for the period 2000 to 2010. This rate was then applied to state-level projections from the U.S. Census Bureau to calculate county-level population projections for 2020 and 2030. Figure 2-5 shows the locations of these areas.

Recreational use of Lake Anna is a significant source of transient population. Use is highest on weekends and during the summer months. A conservatively high estimated total peak daily population on the reservoir is 8,900, with an additional 1,000 using the WHTF. Total annual attendance is conservatively estimated to be about 710,000, based on a 180-day season (Ref. 2.1-1, Section 2.1.3.3).

2.7 Economic Base

The communities potentially impacted socioeconomically by NAPS license renewal activities are in Henrico, Louisa, Orange, and Spotsylvania Counties, all located in central Virginia. This part of Virginia has experienced steady growth in population and economic activity during the last decade.

Henrico County is part of the Richmond-Petersburg metropolitan statistical area, which is home to approximately 950,000 people. The Richmond metropolitan statistical area has a transportation network of trucking and railroad terminals, interstate highway access to main east-west and north-south routes, an international airport, and the westernmost inland port with direct access to the Atlantic, giving it access to both domestic and international markets (Ref. 2.7-1). The Richmond area is headquarters for more than 35 major corporations including nine Fortune 500 companies, 16 Fortune 1000 headquarters, and three Forbes 500 largest private companies (Ref. 2.7-2). Service is the largest employment sector, followed by retail and wholesale trade and government. Phillip Morris USA is the largest private employer in the area (Ref. 2.7-3).

Louisa County is a rural community south of Lake Anna in the central Piedmont region, located in the triangle between Richmond, Fredericksburg, and Charlottesville. Interstate 64 runs east-west through the County, as does a CSX rail line. The County has seen significant growth in population, but relatively little growth in industry (Ref. 2.7-4). Of the 11,644 resident workers, 50 percent commute to jobs outside the County (Ref. 2.7-5). Louisa County is seeking to recruit manufacturing industries, as evidenced by the development of a 500-acre Industrial Air Park (with paved runway, water, sewer, gas, and power) that is owned by the County. Of the County's 16 major employers, 14 employ fewer than 100 employees and the other two employ more than 500 (Ref. 2.7-5).

Orange County is a rural community located in the Piedmont region of Central Virginia, approximately 72 miles west of Richmond, 75 miles southwest of Washington, DC, and 25 miles northeast of Charlottesville. There are two incorporated towns (Orange and Gordonsville) and a planned residential community (Lake of the Woods) (Ref. 2.7-6). The County's economy is led by agribusiness, manufacturing, and commercial/retail services (Ref. 2.7-6). Orange County is Virginia's top grape producer, with the two largest vineyards having bottling facilities onsite (Ref. 2.7-7). There are 419 active farms, averaging 265 acres each, and more than 600 businesses employing more than 7,500 employees. The manufacturing sector employs 26 percent of the County's labor force, followed by the government sector at 23 percent, and trade at 22 percent. Two of the larger employers are manufacturing firms, one producing kitchen cabinets and the other, textiles (Ref. 2.7-6).

Spotsylvania County is located halfway between Washington, DC, and Richmond, Virginia. Economically, it is more associated with the Washington, DC, metropolitan area through the commuting patterns of its residents and federal procurement opportunities (Ref. 2.7-8). It is estimated that 40 to 60 percent of the County's workers commute long distances to jobs outside the County (Ref. 2.7-9). Spotsylvania County is bisected by Interstate 95 and has easy access to major east-west and north-south highway routes. Rail service is also available through CSX transportation, as is a commuter rail service from Fredericksburg and Manassas to Washington, DC. Trade is the largest employment sector, followed by services and construction (Ref. 2.7-8).

The unemployment rate for the Commonwealth of Virginia for 1998 was 2.9 percent. By comparison, Henrico, Louisa, Orange, and Spotsylvania Counties had 1998 unemployment rates of 2.1, 4.7, 2.7, and 1.8 percent, respectively (Refs. 2.7-10 and 2.7-11).

2.8 Taxes

Dominion pays annual property taxes to Louisa, Orange, and Spotsylvania Counties for NAPS. Taxes fund county operations, including school systems. For the years 1995 to 1998, NAPS's property taxes were about 47 percent of Louisa County's property tax revenue, 1.5 percent of Orange County's property tax revenue, and 1.5 percent of Spotsylvania County's property tax revenue. Dominion's annual property tax payments to Louisa County accounted for approximately 25 percent of the County's total annual budget.

Dominion projects that NAPS's annual property taxes will continue to increase slightly through the license renewal period. The potential effects of deregulation are not yet fully known. Any changes to NAPS tax rates due to deregulation, however, would be independent of license renewal. Table 2-3 compares NAPS's tax payments to county property tax revenues and operating budgets in Louisa, Orange, and Spotsylvania Counties.

2.9 Land Use Planning

This section focuses on Henrico, Louisa, Orange, and Spotsylvania Counties, because approximately 73 percent of the permanent NAPS workforce lives in these counties (Section 3.4) and Dominion pays property taxes in all three counties.

The Commonwealth of Virginia mandates that cities and counties have comprehensive land use plans. In the four counties with the greatest potential to be affected, such plans are in place. Henrico County (Ref. 2.9-1), Louisa County (Ref. 2.9-2), Orange County (Ref. 2.7-7), and Spotsylvania County (Ref. 2.9-3) have all experienced significant growth in the last decade, and their comprehensive plans reflect planning efforts and public involvement in the planning process undertaken during the 1990s. Louisa County's plan is currently being updated (Ref. 2.7-4).

Land use planning tools, such as zoning, guide future growth and development. All plans share the goals of encouraging growth and development in areas where public facilities, such as water and sewer systems, already exist or are planned and discouraging strip development along county roads and highways. Three counties, Louisa, Orange, and Spotsylvania, identified in their comprehensive land use plans the goal of preserving and protecting rural land uses for agriculture and forestry. Henrico County characterizes itself as development-friendly and has no areas where it discourages growth. In Spotsylvania County, growth is directed through the designation of a Primary Development Boundary and Planning Districts. Outside the Primary Development Boundary, public services such as sewer and water will not be provided by the County and development is discouraged. The Planning Districts identify areas with unifying characteristics and similar development patterns, allowing the County to better identify the needs of each area. For example, one district is the Lake Anna Resort District (Ref. 2.9-3).

The construction of Lake Anna in 1972 has influenced land use and development trends in Louisa, Orange, and Spotsylvania Counties. In 1998, a committee was formed to examine the Lake Anna watershed and to develop a plan that would allow the three counties to coordinate planning efforts as they address growth management and the protection of the Lake Anna region. Members of the committee include Planning Directors from Louisa, Orange, and Spotsylvania Counties, Executive Directors from Planning District 9, representatives from regional planning organizations, the Lake Anna Advisory Committee, and citizens from the three involved counties. The Lake Anna Special Area Plan was released in draft form in November 1999 (Ref. 2.9-4).

Henrico County

Henrico County is located to the southeast of NAPS, on the north and east boundaries of the city of Richmond. Interstate 64 and Highway 33 are the primary roads connecting NAPS and

the County. Development in Henrico is concentrated in the Interstate 95 corridor and the part of the County that lies west of this corridor. The eastern area of the County is starting to face development pressure (Ref. 2.9-5). As of 1993, some 60 percent of the land in the County was classified as vacant (includes agricultural and forestal use), 4 percent in industrial and commercial uses, and 21 percent in residential use. Between 1983 and 1990, single-family residential use was one of the fastest growing land use categories, increasing by 16 percent (Ref. 2.9-1).

Louisa County

Louisa County lies on the southern shore of Lake Anna. During the 30 years since NAPS was constructed, Louisa County has seen significant growth in population, but relatively little growth in industry. County population increased 27 percent in the 1980s and 14 percent in the 1990s. Projections are for continued significant growth. The areas of the County experiencing growth are not in the towns, but rather in the south end of the County adjacent to the Richmond-Petersburg metropolitan statistical area, the western end of the County closest to Charlottesville, and the shoreline of Lake Anna (Ref. 2.7-4).

The predominant land use in the County is forest; forestry activities are a major contributor to the County's economy through employment, the sale of timber and forest products, and the generation of related support activities. The Virginia Department of Forestry's 1992 survey estimated that more than 228,000 acres (72 percent of the total land area) were in forest cover. The total forested land area of Louisa County has remained essentially constant since the first survey in 1940. Hardwoods, mostly the oak-hickory type, make up 69 percent of the County's forest. Pine cover types comprise 21 percent of the forest. Forest land in Louisa County is privately owned by individuals. Non-industrial private landowners hold 60 percent, farmers 21 percent, corporate owners 10 percent, the forest industry 9 percent, and public owners less than 1 percent (Ref. 2.9-6).

Of the other land uses in Louisa County, agricultural lands occupy 22 percent and water resources about 3 percent. Developed uses occupy 6 percent, with residential development predominating with 5.5 percent of County land area. The increase in residential land use has been significant, up from 1.8 percent in 1979 (Ref. 2.9-2).

Orange County

Orange County lies to the west and north of NAPS, with the southeastern corner of the County containing small portions of Lake Anna. It is an agriculturally-based rural community that is star ting to experience development pressure spilling over from neighboring Spotsylvania County. New development is occurring in the towns of Orange and Gordonsville and along the Route 33 Corridor, where public utilities already exist (Ref. 2.9-7).

Encompassing some 227,200 acres, the County is 58 percent forested, with pine and mixed

hardwoods predominating. Residential, commercial, industrial, and public uses occupy about 5 percent. Agricultural land use covers approximately 37 percent. Agriculture and forestry continue to be important to the economy of the County. Orange County has more land in vineyards than any other county in Virginia, with more than 200 acres under cultivation. The principal livestock industry is beef cattle; the principal crops are grapes and soybeans (Ref. 2.7-7).

Spotsylvania County

Spotsylvania County lies on the northern shore of Lake Anna. During the 1980s and 1990s, it has become one of Virginia's fastest growing counties, changing from a farming community to a mix of suburban and rural development. This growth is due to migration into the County as development pressures from Washington, DC, and the northern Virginia employment areas have fostered development of a bedroom community in the northern and central portions of the County around the City of Fredericksburg and along the Route 3 corridor. There has also been significant growth of recreational and retirement development around Lake Anna.

Historically, agriculture and forestry have been important components of Spotsylvania County's economy. Today, 11 percent is in agricultural land and 64 percent is in forest (Ref. 2.9-3). The predominant forest cover is second-growth hardwoods, loblolly pine, and Virginia pine (Ref. 2.9-8). Developed land (including residential, industrial, commercial, and public lands) cover 25 percent of the County. Residential use represents 22 percent of the developed land (Ref. 2.9-3).

2.10 Social Services and Public Facilities

2.10.1 Public Water Supply

NAPS gets potable water through a series of groundwater wells and is not connected with a municipal system. Because 73 percent of the permanent employees of NAPS reside in Henrico, Louisa, Orange, and Spotsylvania Counties, and it is assumed that any additional employees associated with license renewal would disperse in similar fashion, the following discussion of public water supply systems will focus on these four areas.

Henrico County provides water service to approximately 74,000 residential, commercial, and industrial customers. The County also has service agreements to supply limited amounts of water to Hanover and Goochland Counties (Ref. 2.10-1). Currently, the County purchases its water supply from the City of Richmond, and has no restrictions on amount. Average daily use is currently 35 million gallons per day. A water supply treatment plant, with a capacity of 55 million gallons per day for Henrico County, is under construction and is scheduled to come online in 2003. Permit negotiations with the State of Virginia are already underway to enlarge this plant by 2010 (Ref. 2.10-2).

The City of Richmond's raw water source is the James River and the water supply system has a capacity of 132 million gallons per day. It supplies 62,000 customers in the City. Wholesale contracts to provide water to Chesterfield, Hanover, and Henrico Counties result in the Richmond system serving approximately 500,000 people (Ref. 2.10-3). In 1999, the Richmond Department of Public Works water supply plant treated an average of 83 million gallons per day. Maximum daily production was 128 million gallons per day during the summer of 1999. To meet peak demand, the Department of Public Utilities has a temporary permit to treat 142 million gallons per day. With upgrades to three pumps, the plant's capacity can be increased to 150 million gallons per day. This gives the plant a reserve capacity of 8 million gallons per day. The utility plans to perform plant upgrades and submit permit applications to increase capacity to 150 million gallons per day (Ref. 2.10-4).

About 80 percent of Louisa County's residents get their drinking water from individual groundwater wells. There are 12 small private water supply systems in the County, serving individual subdivisions and trailer parks. The Louisa County Water Authority owns and operates the Northeast Creek Water Treatment Plant, which supplies the Town of Louisa, part of the Town of Mineral, and some County residents. The plant has a capacity of 1 million gallons per day and an average daily use of 300,000 gallons. Sources for the plant are the Northeast Creek reservoir and a groundwater well at the Industrial Park, which has a 500,000-gallon capacity storage tank, used only as a supplement. To provide for industrial

users, two new groundwater wells and a storage tank are under construction at the Zion's Crossroads Area (Ref. 2.10-5).

In Orange County, approximately 90 percent of the residents get drinking water from individual groundwater wells. The Town of Orange owns and operates a 2-million-gallon-per day-capacity water treatment plant that supplies the town. Water is drawn from the Rapidan River (in Northern Orange County) and is dependent on river flow for supply, there being no reservoir for storage capacity (Ref. 2.9-7). The current average daily usage is 1.5 million gallons. Approximately half of the plant production (16 million gallons per month) is sold to the Rapidan Service Authority, which supplies the Town of Gordonsville through its Route 15 facility (Ref. 2.10-6). The Service Authority owns and operates two other facilities in Orange County. The Route 20 water treatment plant supplies 50 to 60 homes and is at capacity. Its water source is a single groundwater well with average usage of 15,000 gallons per day. The Wilderness treatment plant has a 1.6 million gallon per day capacity with average usage of 400,000 gallons per day. Its water source is the Rapidan River and it supplies the Town of Wilderness and the Lake of the Woods area (Ref. 2.10-7). The two main water treatment plants supplying municipal water in Orange County have as their water source the Rapidan River. In times of drought, this source may not be sufficient to supply demand. Alternative means to obtain raw water, such as the construction of reservoirs and groundwater wells, are under consideration by the County.

Spotsylvania County has a public water system that supplies most residential, commercial, and industrial areas within the County. Rural areas of the County are served by wells and springs (Ref. 2.10-8). The County owns and operates the Ni River Treatment Plant, which draws its water from the Ni River. Plant capacity is 6 million gallons per day, and average daily usage is 4.5 million gallons. Construction has begun on a 12 million-gallon-per-day plant, Mott's Run, which will draw water from the Rappahannock River and supply both the County and the City of Fredericksburg, Virginia (Ref. 2.10-9).

In conclusion, public water supply is not a constraint to growth in the Central Virginia region surrounding NAPS. Although there are supply concerns in some individual municipalities, in the four counties where it is assumed that the majority of new employees associated with license renewal would reside, there are no limitations on either new onsite groundwater wells or the reserve capacities of existing municipal systems. Where municipal systems are approaching the limits of their reserve capacities, plans are in place to address these issues.

2.10.2 **Transportation**

Road access to the NAPS is via State Highway 700, a two-lane paved road (Figure 2-1). State Highway 700 intersects State Highway 652 approximately one-half mile from the plant.

The major commuting routes utilize State Highways 700, 652, 208, 522, and 618 in the immediate vicinity of NAPS. These roads all carry a level of service designation of "B" (Ref. 2.10-10). Table 2-4 compares the characteristics of the different levels of service designations.

2.11 Minority and Low-Income Populations

The NRC performed environmental justice analyses for Calvert Cliffs Nuclear Power Plant and Oconee Nuclear Station license renewals (Refs. 2.11-1, Section 4.4.6; and 2.11-2, Section 4.4-6). In doing so, NRC used a 50-mile radius as the environmental impact site and the state as the geographic area for comparative analysis. Dominion adopted this approach for identifying the NAPS minority and low income populations.

The NRC guidance calls for use of the most recent U.S. Census Bureau decennial census data. Dominion used 1990 census data from the U.S. Census Bureau website (Ref. 2.11-3, 1990 U.S. Census data) to determine the percentage of total population within Virginia and Maryland for each minority category and to identify minority and low-income populations within 50 miles of NAPS. The U.S. Census Bureau provides updated annual population projections for selected portions of its demographic information. However, the updated projections are not available for census-tract levels of analysis. Dominion used ArcView® geographic information system software to combine U.S. Census Bureau tract data with Environmental Systems Research Institute (Ref. 2.11-4) tract-boundary spatial data to determine the minority and low-income characteristics on a tract-by-tract basis. Dominion included census tracts if at least 50 percent of their area lay within 50 miles of NAPS. The 50-mile radius includes 351 census tracts.

2.11.1 Minority Populations

The NRC guidance for performing environmental justice reviews defines "minority" as: American Indian or Alaskan Native; Asian or Pacific Islander; Black, not of Hispanic origin; or Hispanic (Ref. 2.11-5, Attachment 4). The guidance indicates that a minority population exists if either of the two following conditions exists:

> exceeds 50 percent – the minority population of the environmental impact site exceeds 50 percent, or
>
> more than 20 percent greater – the minority population percentage of the environmental impact site is significantly greater (typically at least 20 percent) than the minority population percentage in the geographic area chosen for comparative analysis.

Dominion divided U.S. Census Bureau population numbers for each minority within each tract by the total population for the appropriate state (Virginia or Maryland) to obtain the percent of total population represented by each minority. Table 2-5 shows the result of this calculation and the threshold for determining whether or not a minority population exists. Because the state percentages are low, the "more than 20 percent greater" criterion is more encompassing than the "exceeds 50 percent" criterion. For example, if 40 percent of a tract

was Black, it would not contain a minority population under the "exceeds 50 percent" criterion. However, because 19 percent of the Virginia population is Black, the tract would contain a minority population under the "more than 20 percent greater" criterion because 40 percent does exceed 39 percent (19 percent plus 20 percent).

For each of the 351 census tracts within 50 miles of NAPS, Dominion calculated the percent of the population in each minority category and compared the result to the corresponding threshold percent to determine whether minority populations exist.

Based on the "more than 20 percent greater" criterion, Black minority populations exist in 60 census tracts: 58 in Virginia and 2 in Maryland. Forty-one of these tracts are within the Richmond city limits. One tract in Stafford County contains a Native American minority population. Figure 2-6 shows the locations of the Black minority and Native American minority populations; all are more than 12 miles from NAPS. Black minority populations tend to be concentrated in the City of Richmond and rural areas to the southwest and east of NAPS. Table 2-5 presents the number of census tracts within each state that exceed the threshold for determining the presence of a minority population.

2.11.2 Low-Income Populations

NRC guidance defines "low-income" using U.S. Census Bureau statistical pover ty thresholds (Ref. 2.11-5, Attachment 4). The guidance indicates that a low-income population exists if the percentage of households below the pover ty level in an environmental impact site is significantly greater (typically at least 20 percent) than the low-income population percentage in the geographic area chosen for comparative analysis. U.S. Census Bureau data (Ref. 2.11-3) characterizes 11 percent of Virginia and 8 percent of Maryland households as low-income. Applying this NRC criterion, 17 census tracts contain low-income populations. Table 2-5 presents the number of census tracts within each state that exceed the threshold for determining the presence of low-income populations. Census tracts containing low-income populations are concentrated in urban/suburban areas: 12 tracts in the City of Richmond, 4 tracts in the City of Charlottesville, and 1 tract in Chesterfield County. Figure 2-7 shows the locations of the low-income populations.

2.12 Meteorology and Air Quality

Louisa County, where NAPS is located, is part of the Northeastern Virginia Intrastate Air Quality Control Region (AQCR). The AQCR is designated as being in attainment for carbon monoxide, sulfur dioxide, nitrogen dioxide, particulate matter with an aerodynamic diameter < 10 microns, and lead. Virginia has been designated as being nonattainment for the 1-hour ozone standard. Virginia will likely be designated nonattainment as well, with respect to the new, more stringent 8-hour ozone standard, although this new 8-hour standard, promulgated in 1997, is currently not enforceable, pending further order of the U.S. District Court of appeals in the District of Columbia Circuit. There are no maintenance areas within 50 miles of NAPS. (Refs. 2.12-1; 2.12-2; 2.12-3; and 2.12-4)

2.13 Historic and Archaeological Resources

Although the construction of the nuclear facilities and reservoir in the 1970s did not uncover or inundate anything of national historic or archaeological significance, there are numerous historical sites near NAPS (Ref. 2.13-1). During highway work performed in connection with the reservoir, Dominion did locate an old cast iron fireback. The relic was identified as having been made at the Fredericksville Furnace, making it the oldest known Virginia iron casting attributable to a specific manufacturer. It was donated to the Association for the Preservation of Virginia Antiquities, which subsequently put out it on indefinite loan to Colonial Williamsburg (Ref. 2.13-1). Within Louisa County, there are currently 12 sites listed on the National Register of Historic Places (Ref. 2.13-2), as listed in Table 2-6. There are several colonial era sites (Boswell's Tavern, Jerdone Castle, and Cuckoo) in the vicinity. Jerdone Castle is the closest (3 miles) to the site. The NAPS transmission line corridors do not cross over any known historic or archaeological sites. Other sites of historical interest related to the Revolutionary and Civil Wars are in the vicinity of Petersburg, Richmond, and Fredericksburg.

Historical Landmark of the Fredericksville Furnace

TABLES AND FIGURES

Table 2-1
Threatened or Endangered State and Federal Species That Occur or Could Possibly Occur at North Anna Power Station and/or Along Associated Transmission Lines

Scientific Name	Common Name	Federal Status[a]	Commonwealth Status[a,b]
Mammals			
Plecotus rafinesquii	Eastern big-eared bat	-	E
Birds			
Aimophila aestivalis	Bachman's sparrow	-	T
Ammodramus henslowii	Henslow's sparrow	-	T
Bartramia longicauda	Upland sandpiper	-	T
Falco peregrinus	Peregrine falcon	-	E
Haliaeetus leucocephalus	Bald eagle	T	T
Lanius ludovicianus	Loggerhead shrike	-	T
Amphibians			
Ambystoma tigrinum	Tiger salamander	-	E
Hyla gratiosa	Barking treefrog	-	T
Invertebrates			
Alasmidonta heterodon	Dwarf wedgemussel	E	E
Fusconaia masoni	Atlantic pigtoe	-	T
Vascular Plants			
Helonias bullata	Swamp-pink	T	E
Isotria medeoloides	Small whorled pogonia	T	E

a. T = Threatened; E = Endangered; S/A = due to similarity of appearance; - = Not listed.

b. A third state category, "special concern" has been excluded from this table. "Special concern" is not a legal category, but identifies species about which the state is concerned.

a. Ref. 2.6-3.

Table 2-2
Estimated Populations and Annual Growth Rates in Henrico, Louisa, Orange, and Spotsylvania Counties from 1980 – 2030

	Population and Average Annual Growth Rate in the Previous Decade							
	Henrico County		Louisa County		Orange County		Spotsylvania County	
Year	Population	Average Annual Growth (as %)	Population	Average Annual Growth (as %)	Population	Average Annual Growth (as %)	Population	Average Annual Growth (as %)
1980	180,735[a]	1.7	17,825[a]	2.7	18,063[a]	3.1	34,435[a]	10.7
1990	217,881[a]	2.1	20,325[a]	1.4	21,421[a]	1.9	57,403[a]	6.7
2000	249,004[b]	1.4	25,407[b]	2.5	25,399[b]	1.9	86,500[b]	5.1
2010	277,003[b]	1.1	30,003[b]	1.8	29,801[b]	1.7	110,999[b]	2.8
2020	305,180[c]	1.0	34,628[c]	1.5	34,231[c]	1.5	135,654[c]	2.2
2030	333,179[c]	0.9	39,224[c]	1.3	38,633[c]	1.3	160,153[c]	1.8

a. Ref. 2.6-3.
b. Ref. 2.6-4.
c. Ref. 2.6-5.

Table 2-3
Property Tax Revenues Generated in Louisa, Orange, and Spotsylvania Counties, Virginia; Property Taxes Paid to Louisa, Orange and Spotsylvania Counties by North Anna Power Station; and Louisa, Orange, and Spotsylvania Counties Operating Budgets; 1995 – 1998

Year	Total Property Tax Revenues	Property Tax Paid to County for NAPS	Percent of Total Property Taxes	Total Budget
		Louisa		
1995	Not Available	$10,683,585[b]	Not Available	$61,218,248[a]
1996	$22,761,970[a]	$11,115,929[b]	49	Not Available
1997	$24,082,838[a]	$11,361,154[b]	47	$45,155,803[a]
1998	$24,116,482[a]	$11,006,924[b]	46	$45,088,350[a]
		Orange		
1995	$7,811,992[c]	$119,713[b]	1.5	$32,212,892[c]
1996	$8,047,224[c]	$128,328[b]	1.6	$34,214,668[c]
1997	$8,662,086[c]	$125,590[b]	1.4	$35,679,113[c]
1998	$9,354,981[c]	$146,268[b]	1.6	$38,328,996[c]
		Spotsylvania		
1995	$30,676,005[d]	$466,998[b]	1.5	$127,037,157[d]
1996	$32,894,971[d]	$491,668[b]	1.5	$131,403,347[d]
1997	$35,742,696[d]	$519,070[b]	1.5	$152,712,966[d]
1998	$38,531,812[d]	$558,833[b]	1.5	$184,888,334[d]

a. Ref. 2.8-1.
b. Ref. 2.8-2.
c. Ref. 2.8-3.
d. Ref. 2.8-4.

Table 2-4
Level-of-Service Designation Characteristics

Level of Service	Conditions
A	Free flow of the traffic stream; users are unaffected by the presence of others.
B	Stable flow in which the freedom to select speed is unaffected, but the freedom to maneuver is slightly diminished.
C	Stable flow that marks the beginning of the range of flow in which the operation of individual users is significantly affected by interactions with the traffic stream.
D	High-density stable flow, in which speed and freedom to maneuver are severely restricted; small increases in traffic will generally cause operational problems.
E	Operating conditions at or near capacity level, causing low but uniform speeds and extremely difficult maneuvering that is accomplished by forcing another vehicle to give way; small increases in flow or minor perturbations will cause breakdowns.
F	Defines forced or breakdown flow that occurs wherever the amount of traffic approaching a point exceeds the amount which can traverse the point. This situation causes the formation of queues characterized by stop-and-go waves and extreme instability.

Source: Ref. 2.6-1, Section 3.7.4.2.

Table 2-5
Minority and Low-Income Population Census Tracts

Category[a]	State Average (Percent)[b]		Threshold for Minority/ Low-Income Population (Percent)[c]		Number of Census Tracts within 50-mile radius Exceeding Threshold	
	Virginia	Maryland	Virginia	Maryland	Virginia	Maryland
American Indian or Alaskan Native	<1	<1	20	20	1	0
Asian or Pacific Islander	3	3	23	23	0	0
Black (Non-Hispanic Origin)	19	25	39	45	58	2
Hispanic	3	3	23	23	0	0
Low-Income	11	8	31	28	17	0

a. As defined by Ref. 2.11-5, Attachment 4.
b. Source: U.S. Census Bureau Website (Ref. 2.11-3).
c. At least 20 percent greater than State average (Ref. 2.11-5, Attachment 4).

Table 2-6
Louisa County, Virginia, Sites on the National Register of Historic Places

Site Name	Location
Anderson-Foster House	North of Holly Grove
Boswell's Tavern	Junction of State Highway 22 and U.S. Highway 15 in Gordonsville
Cuckoo	Junction of State Highway 33 and State Highway 522 South
Grassdale	West of Trevilians off U.S. Highway 15
Green Springs	0.2 miles south of State Highway 617 and 1.5 miles southwest of junction with State Highway 640 in Trevilians
Green Springs Historic District	Northeast of Zion Crossroads on U.S. Highway 15
Hawkwood	South of Gordonsville off U.S. Highway 15
Ionia	0.1 mile east of state Highway 640 and 0.8 mile north of junction with State Highway 613 in Trevilians
Jerdone Castle	North of Bumpas
Louisa County Courthouse	Junction of Main Street and State Highway 208 in Louisa
Providence Presbyterian Church	Northwest of Gum Spring off U.S. Highway 250
Westend	South of junction of State Highways 22 and 638 in Trevilians

Source: (Ref. 2.13-2).

Figure 2-1
Dominion – 10 Mile North Anna Vicinity Map

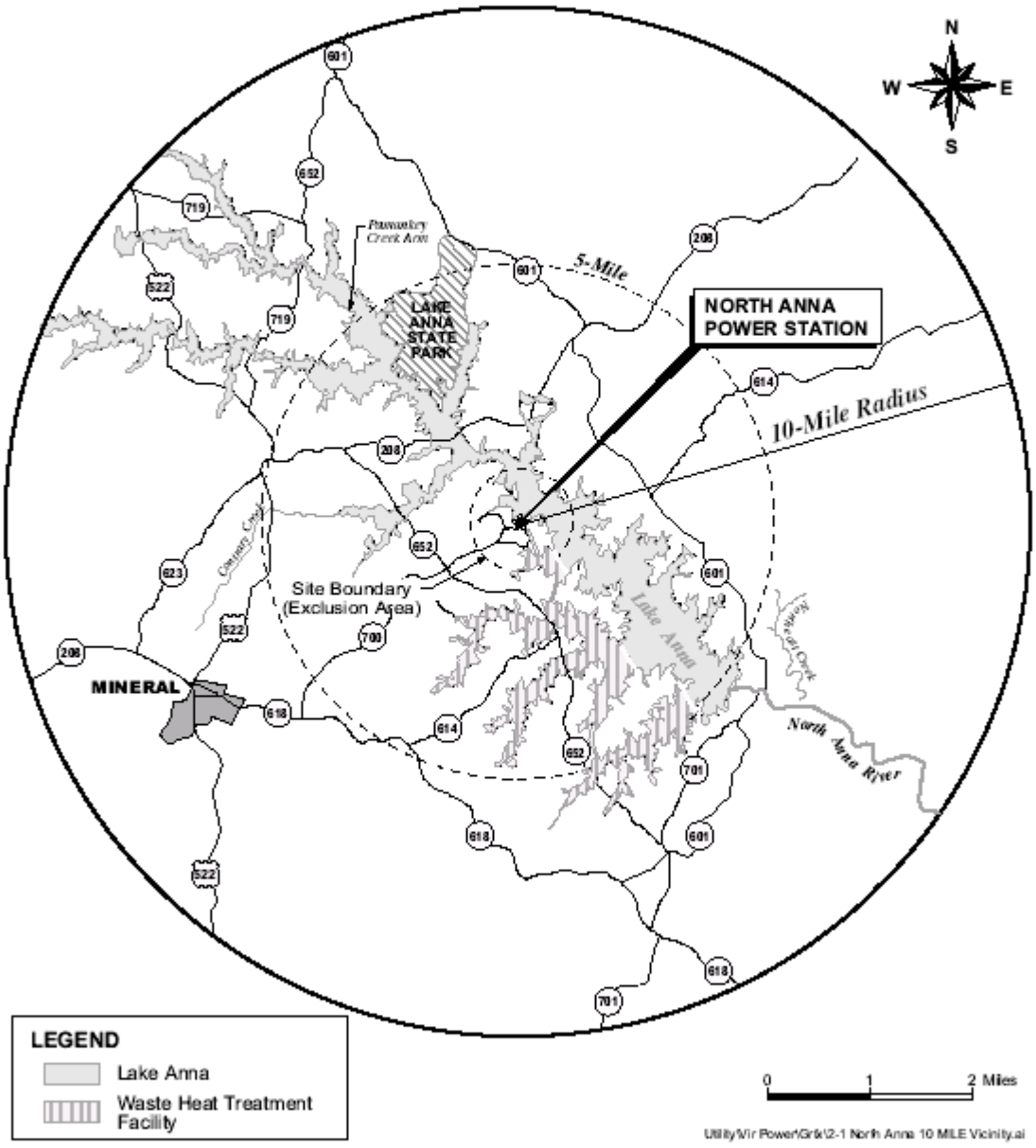


Figure 2-2
Dominion – North Anna Power Station 50 Mile View

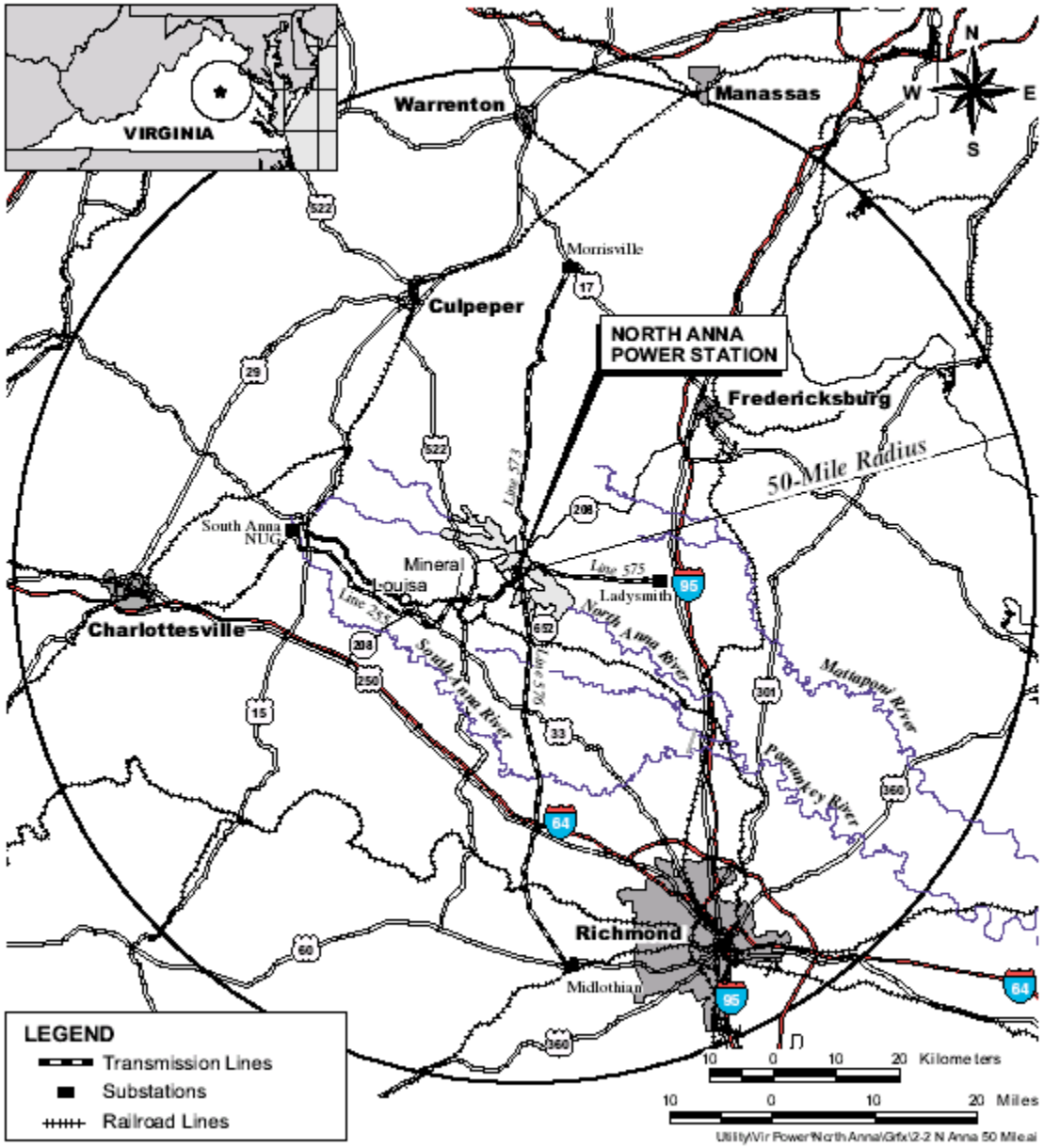


Figure 2-3
Dominion – North Anna Site

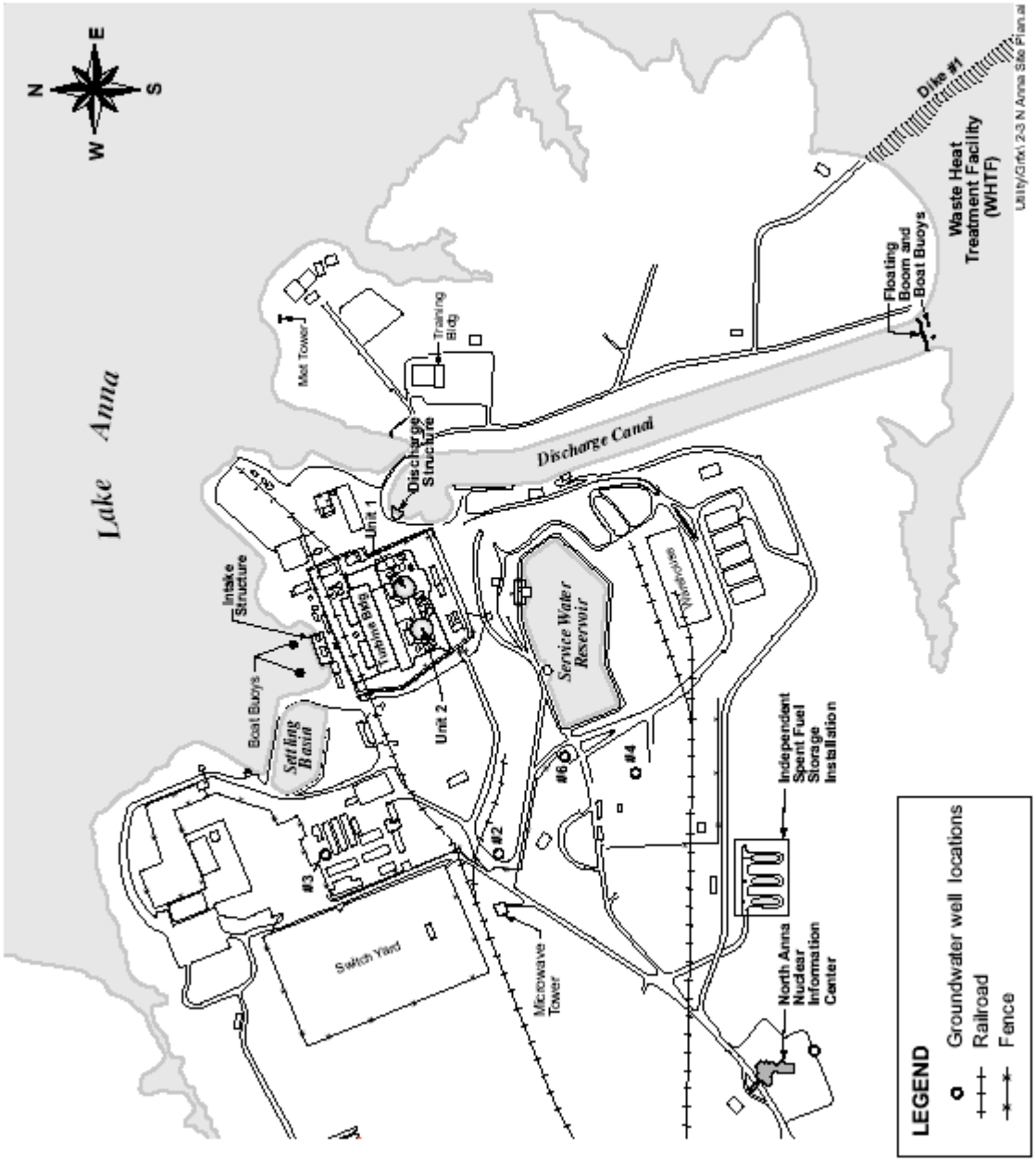


Figure 2-4
Schematic Cross-Sectional Diagram of Water-Discharge System at Dike 3 Waste Heat Treatment Facility (WHTF)

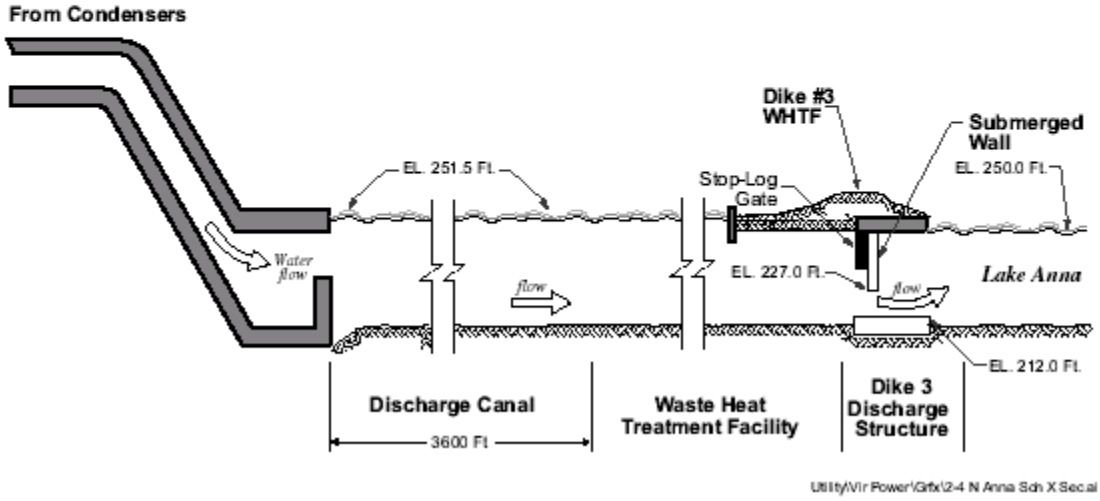


Figure 2-5
North Anna Power Station, 50 Mile Vicinity Map Showing Counties and Important Towns and Cities

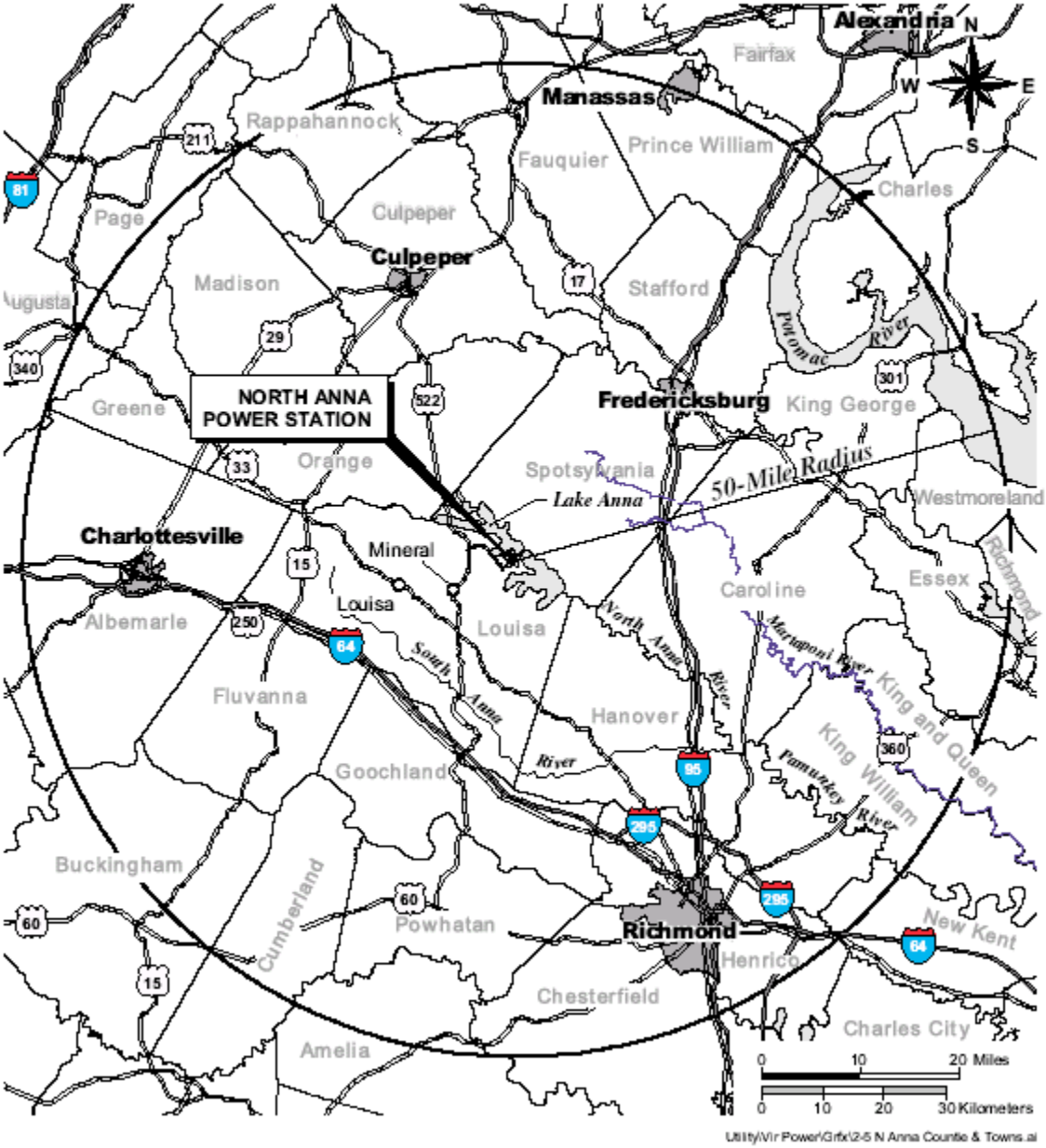


Figure 2-6
Dominion - NAPS Minority Population

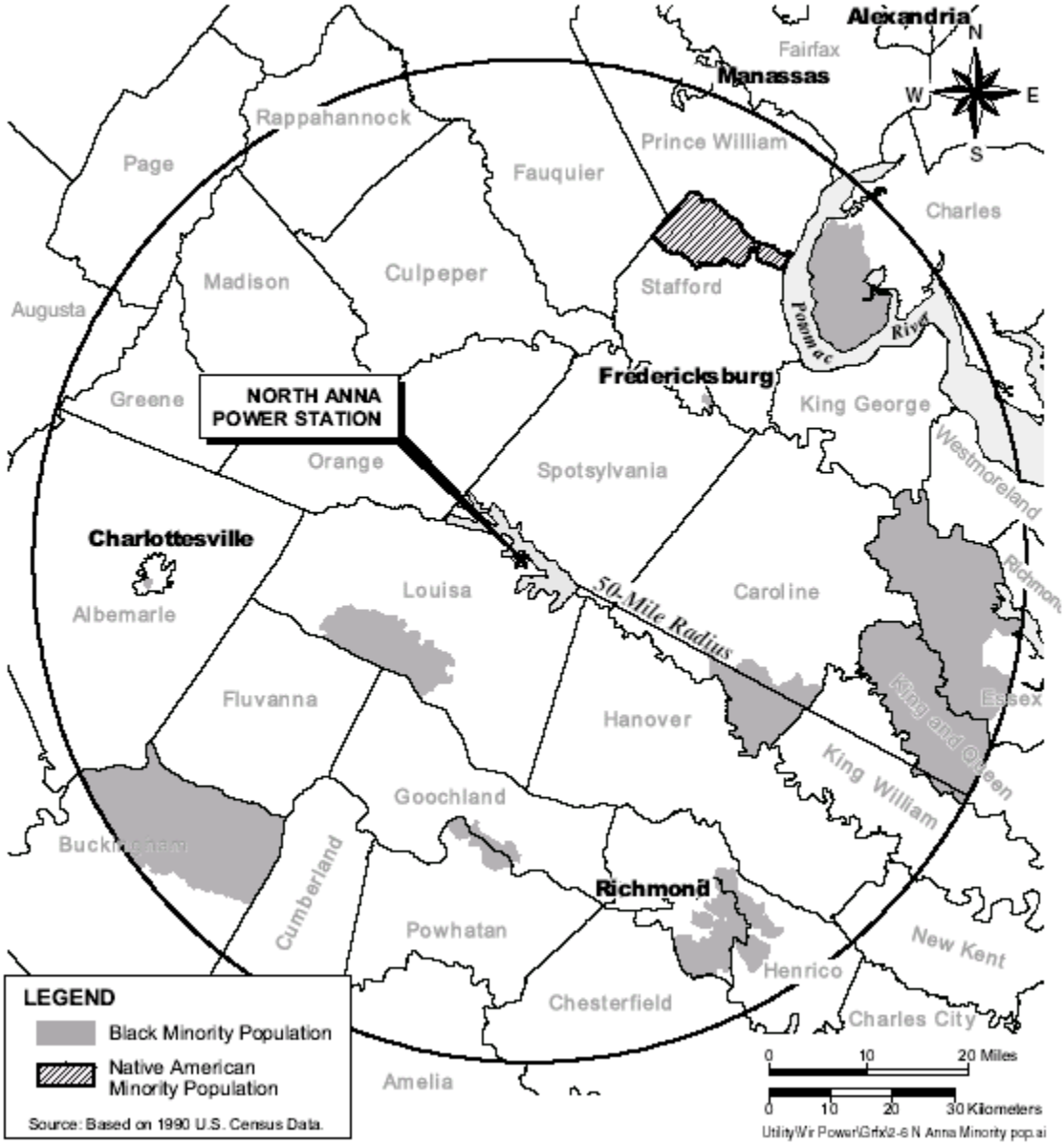
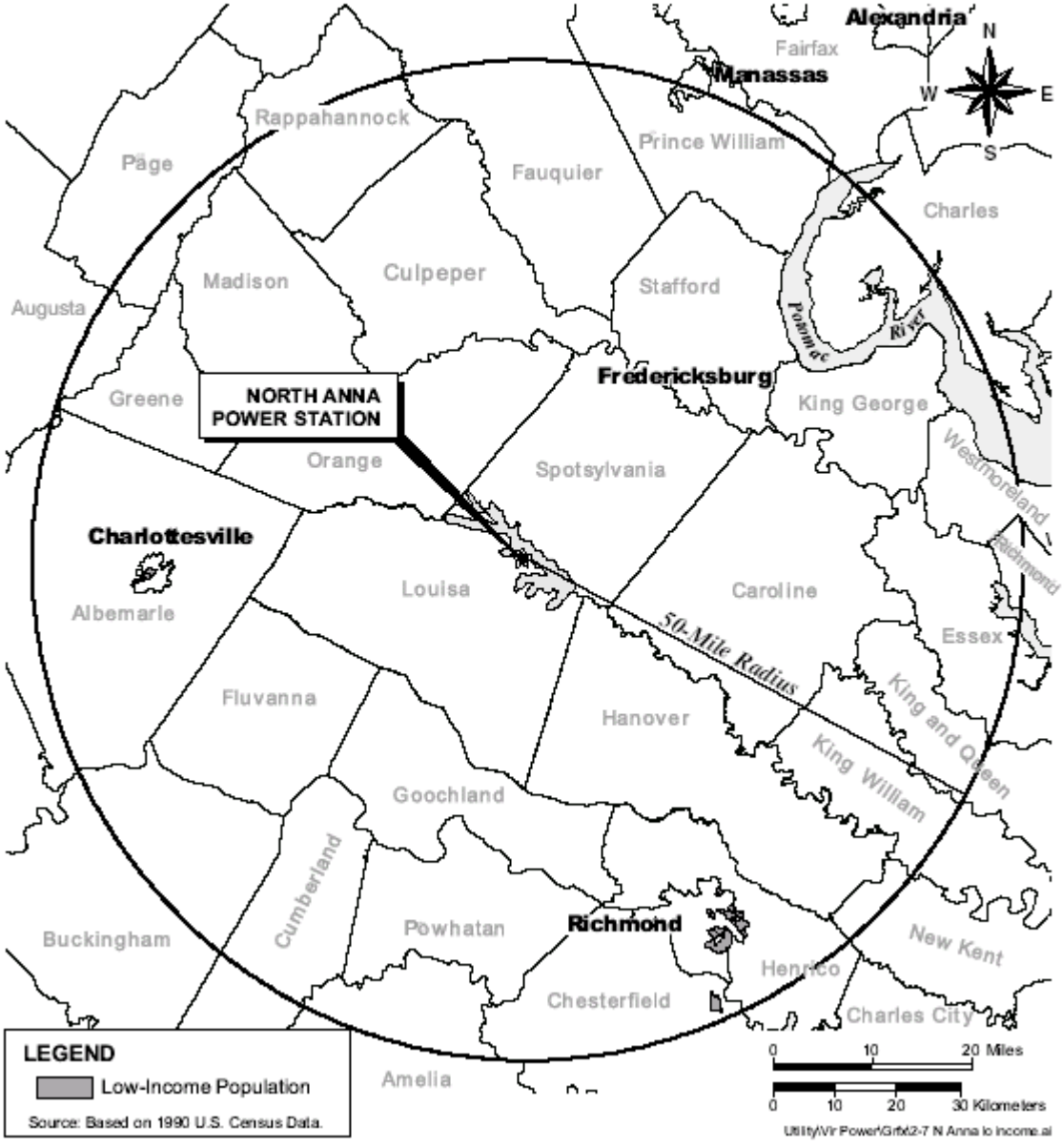


Figure 2-7
Dominion - NAPS Low-Income Population



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3.0 PROPOSED ACTION

NRC Input

"…The report must contain a description of the proposed action, including the applicant's plans to modify the facility or its administrative control procedures…. This report must describe in detail the modifications directly affecting the environment or affecting plant effluents that affect the environment…." 10 CFR 51.53(c)(2)

Dominion proposes that the U.S. Nuclear Regulatory Commission (NRC) renew the North Anna Power Station Units 1 and 2 (NAPS) operating licenses for an additional 20 years. Renewal would give Dominion and the Commonwealth of Virginia the option of relying on NAPS to meet Virginia's future needs for electric generation. Section 3.1 discusses the plant in general. Sections 3.2 through 3.4 address potential changes that could be required to support renewed operating licenses. Section 3.5 discusses the North Anna Hydroelectric Project, located at the North Anna Dam.

3.1 General Plant Information

General information about NAPS is available in several documents. In 1973, the U.S. Atomic Energy Commission, the predecessor agency of NRC, prepared Final Environmental Statements for operation of NAPS Units 1 and 2 (Ref. 3.1-1). The NRC *Generic Environmental Impact Statement for License Renewal of Nuclear Plants* (GEIS) (Ref. 3.1-2)
describes NAPS features and, in accordance with NRC requirements, Dominion maintains an updated Final Safety Analysis Report for the units (Ref. 3.1-3). Dominion has referred to each of these documents while preparing this environmental report for license renewal.

3.1.1 Reactor and Containment Systems Reactor

NAPS is a two-unit plant as shown in Figure 3-1. Each unit includes a three-coolant-loop pressurized light-water reactor nuclear steam supply system and steam-driven turbine generator manufactured by Westinghouse. The balance of each unit was designed by Dominion with the assistance of its agent, Stone & Webster Engineering Corporation. Each unit was warranted for an output of 2,775 megawatts-thermal (MWt), with a corresponding gross electrical output of approximately 907 megawatts-electrical (MWe). Units 1 and 2 achieved commercial operation in June 1978 and December 1980, respectively. In 1986, based on an NRC-prepared environmental assessment and finding of no significant impact, both units were uprated to a core power output of 2,893 MWt with an expected gross output of 982 MWe (Ref. 3.1-3, pp. 1.1-1 - 1.1-2; Ref. 3.1-4, pp. 28784 - 85) and net total capacity of 1,790 MWe (Ref. 3.1-5, pg. 1).

[picture not included] North Anna Power Station

Containment

Each reactor containment structure is a steel-lined, reinforced-concrete cylinder with a hemispheric dome and a flat reinforced-concrete foundation mat (Ref. 3.1-3, pg. 1.2-1). The concrete thickness of the vertical walls is 4.5 feet, with an outside diameter of 135 feet. Thickness in the dome is 2.5 feet, and the overall height is approximately 191 feet. Air pressure inside each containment structure is maintained 5 pounds per square inch gage (psig) below atmospheric pressure for routine operation. Together with its engineered safety features, each containment structure is designed to withstand an internal pressure of 45 psig above atmospheric pressure accompanying the design-basis loss-of-coolant accident, is leak-tight, and provides radiation shielding for both normal operation and design-basis accident conditions (Ref. 3.1-3, Table 1.3-3, pg. 1.3-15).

Fuel

NAPS fuel is slightly enriched uranium dioxide; the current enrichment limit is 4.3 percent by weight uranium-235 (Ref. 3.1-3, pg. 4.3-31). Dominion operates the reactors at a region average fuel discharge burnup rate of 43,000 to 45,000 megawatt-days per metric ton uranium (Ref. 3.1-3, pg. 4.3-7).

3.1.2 Cooling and Auxiliary Water Systems

3.1.2.1 Surface Water

NAPS uses a once-through cooling system to dissipate heat from the turbine condensers (circulating water system). When both units are operating, eight circulating water pumps draw water from Lake Anna at a rate of 4,246 cubic feet per second (cfs) or 1,906,000 gallons per minute (gpm), circulate it through the condensers and return it to the reservoir via a 3,400-acre waste heat treatment facility (WHTF). The temperature of the cooling water is increased about 14.5°F (at design station load) as it moves through the condensers (Ref. 3.1-6, Section 3.3).

During operation, heat generated in each reactor is transferred through the primary cooling system to the steam generators. Each nuclear unit has three separate closed-cycle loops, with one steam generator per loop. Steam produced in the generators is transferred to the steam turbines, which drive the generators that produce electricity. After passing through the turbines, spent steam is condensed and returned to the steam generators, and the cycle is repeated. Condensers at NAPS are equipped with an Amertap system that circulates sponge rubber balls through the condenser tubes to prevent the accumulation of deposits (such as biofouling organisms) (Ref. 3.1-1, Section 3.5). Amertap balls are slightly larger than the inside diameter of the condenser tubes; they are collected from the outlet stream and reused. No chemical biocides are used in the circulating water system.

Cooling water for the circulating water system is withdrawn from Lake Anna through two screenwells (one per nuclear unit) located in a cove just north of the Station (see Figure 2-3). Each screenwell contains four intake bays. Each intake bay is equipped with a trash rack, a travelling screen, and a circulating water pump. The travelling screens, with 3/8-inch square openings, are designed to move every 24 hours or when a predetermined pressure differential exists across the screens. Debris and fish collected from the travelling screens are washed into wire baskets for disposal as solid waste, as required by the NAPS Virginia Pollutant Discharge Elimination System (VPDES) Permit No. VA0052451. Circulating water is pumped from the intake through the steam condensers and discharged through rectangular tunnels into the discharge canal (see Figure 2-3). This canal, which is 27 feet deep and 100 feet wide (with side slopes of 1:2.5), is designed to convey the entire cooling water flow a distance of about 3,600 feet (at a velocity of 2 feet per second) to the head of the WHTF (Ref. 3.1-1, Section 3.3).

The WHTF, formed by diking off the three southern-most arms of Lake Anna, consists of three cooling lagoons interconnected by canals (Figure 3-2) and is a recognized treatment facility by the Commonwealth of Virginia. When filled to elevations of 251.5 feet, these lagoons have a total surface area of 3,400 acres (Ref. 3.1-1, Section 3.3). Heated effluent moves from the first cooling lagoon to the second cooling lagoon via Canal B, and from the second to the third (and last) cooling lagoon via Canal C.

As noted previously in this section, the design temperature increase across the condensers is 14.5°F, but may be increased or decreased depending on the power station load and the number of circulating water pumps operating at a given time (Ref. 3.1-6, Section 3.3). At lower condenser flow rates (three circulating water pumps operating rather than four), the temperature increase across the condenser is higher, averaging approximately 18.3°F, because the temperature rise is inversely proportional to the condenser flow rate and directly proportional to the heat rejection rate (Ref. 3.1-6, Section 3.3). A minimum of three circulating water pumps are required for each operating unit in the summer months, when the intake temperature exceeds 75°F.

The cooling water residence time in the WHTF is approximately 14 days, depending on condenser flow rate (Ref. 3.1-6, Section 3.3). More than half the Station's waste heat is dissipated in the WHTF. The only discharge from the WHTF into Lake Anna is at Dike 3, located in the lower portion of the reservoir near the dam. Dike 3, which is designated Outfall 001 in the Station's current VPDES permit, is the point at which the Station's condenser cooling water actually discharges to waters of the Commonwealth (Lake Anna). The discharge is a submerged, high-velocity jet that promotes rapid mixing with reservoir waters. Effluent from the WHTF enters Lake Anna through a six-bay skimmer wall discharge structure built within Dike 3 (Figure 3-2). Each discharge bay contains a stop-log gate that adjusts the effective area of discharge so the discharge velocity is maintained at about 7 feet per second (Ref. 3.1-6, Section 3.3). Although the discharge from this structure is submerged, the slope of the reservoir bottom immediately adjacent to the structure directs the discharge to the surface. The warmer, less dense heated effluent tends to (in the absence of wind-driven disturbances) lie on the surface of the reservoir, where the remaining waste heat is dissipated to the atmosphere.

Monthly heat rejection rates for the period from 1978 to 1985 were summarized in the 1986 Section 316(a) Demonstration for North Anna Power Station (Ref. 3.1-6). From 1981 to 1985, when two units operated, monthly heat rejection rates ranged

from 1.42 × 10^8 British thermal units per hour (Btu/hr) in September 1984 to 1.26 × 10^{10} Btu/hr in June 1985. The current VPDES permit (see Appendix B) limit is 1.354 × 10^{10} Btu/hr, a limit that has not been exceeded to date. Dominion conducted quarterly field temperature surveys in 1983, 1984, and 1985 to characterize the thermal plume entering Lake Anna via the discharge structure at Dike 3 (Ref. 3.1-6, Section 3.5). These surveys were intended to build on and refine the results of previous pre-operational and operational studies of Lake Anna's thermal characteristics, as well as computer simulations of the reservoir's annual heat budget (including thermal capacity and maximum predicted water temperatures) and thermal performance under various meteorological and operating conditions.

The high-velocity jet discharge at Dike 3 maximizes the mixing of the heated effluent in the Lower Lake. Field studies in 1983 and 1985 (1984 data was not directly comparable, because the station was operating at a reduced power level) showed that, during the hottest month of the year (July), near-maximum operating temperatures did not produce a distinct thermal plume in the Lower Lake (Ref. 3.1-6, Section 3.5). In fact, results showed nearly uniform temperatures occurring across horizontal layers. There was also no clearly defined thermal plume in the Lower Lake in fall, winter, or spring.

Results of quarterly plume studies, conducted over a recent (1994-1998) five-year period as part of the post-316(a) Demonstration monitoring (see Section 2.2), were similar. Typically, no thermal plume was evident in spring and summer surveys. In cooler months, there were noticeable differences between Upper Lake, Mid-Lake, and Lower Lake temperatures (both at surface and at depth), but differential cooling and warming of surface waters in the shallow Upper Lake and the deeper Lower Lake made it difficult to identify or precisely define a thermal plume.

[picture not included] North Anna Power Station service water system

The service water system, normally operated as a closed-loop system, uses a 9-acre (Ref. 3.1-8) reservoir (see Figure 2-3) and spray array to dissipate heat from the component cooling system heat exchangers and other minor system loads. The service water system includes four service water pumps that supply water to two loops (A and B), with makeup water from Lake Anna provided via the circulating water system intake. One service water pump is normally used to supply water to one loop at a nominal rate of 11,500 gpm (Ref. 3.1-3, Section 9.2.1.2.1). Depending on system loads and water temperatures, water may be pumped directly to the service water reservoir or passed through the spray array system for pre-cooling. The service water spray system consists of four pairs of individually controlled spray arrays. Each pair of arrays is capable of handling 100 percent of the service water flow and heat load generated by one unit during normal operation (Ref. 3.1-3, Section 9.2.1.2.2). In winter months, when heat loads are reduced, motor-operated valves may be set to bypass the spray arrays. During these periods, water flows from the outlet of the component cooling system heat exchangers directly to the service water reservoir with no pre-cooling. Overflow from the service water system flows to the (circulating water system) discharge canal via a VPDES-permitted and monitored outfall (Outfall 108). Section 9.2 of the NAPS Updated Final Safety Analysis Report (Ref. 3.1-3) contains detailed descriptions of the service water system and component cooling system.

3.1.2.2 **Groundwater**

NAPS has 10 groundwater withdrawal wells for domestic use. Six are permitted by the Commonwealth of Virginia's Department of Environmental Quality (Table 9-2) and are subject to withdrawal reporting requirements. The remaining four wells do not require permits or reporting, due to their small size. Table 3-1 shows monthly withdrawal quantities that Dominion reported to the permitting authority, the Commonwealth of Virginia's Department of Health, Division of Water Supply Engineering, for 1991 through 1999. The highest monthly withdrawal during this period was 1.83 million gallons in March 1994 (Table 3-1), representing an average of approximately 41 gpm. The limited use of the smaller wells is not expected to add more than 1 to 2 gpm to the NAPS average pumping rate.

3.1.3 **Transmission Facilities**

Dominion built four transmission lines for the specific purpose of connecting NAPS to the transmission system. Beginning at NAPS, these transmission lines occupy four corridors that run to the north, south, east, and west (see Figure 2-2). "Corridor" is a general term used to identify the land over which a transmission line travels. A utility may own the land, in which case it holds the corridor as a property owner. More commonly, others own the land and the utility owns the right, called an easement, to install and maintain the transmission line on the land. In the case of an easement, the corridor is commonly called a right-of-way. Most NAPS transmission line corridors are rights-of-way, with a small percentage (less than 1 percent) of the acreage owned outright.

The 1973 NAPS Final Environmental Statement (Ref. 3.1-1, Section 3.7) identifies four 500-kV[1] lines to be constructed to provide power to the Dominion electric power grid. One line, the Possum Point line, was never constructed. The other three were constructed in 1973, 1976, and 1979. The list below identifies each transmission line by the line number and name of the substation at which each line connects to the overall electric power grid.

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1. A primary characteristic of a transmission line is the voltage, measured in kilovolts (kV). The GEIS indicates that transmission lines use voltages of approximately 115 to 138-kV and higher and that, in contrast, distribution lines use voltages below 115 or 138-kV (Ref. 3.1-2, Section 4.5.1, pg. 4-59). The NAPS transmission lines operate at one of two voltages: either 230-kV or 500-kV.

[picture not included] North Anna Power Station switchyard
[picture not included] Dominion transmission lines

The accompanying paragraphs provide other features of the transmission lines, including voltage, right-of-way width and length, and existence of other lines in the right-of-way.

- Line 573 to Morrisville – The northerly line to the Morrisville Substation near Morrisville, Virginia, operates at 500 kV. This corridor is approximately 33 miles long and contains only line 573. The right-of-way width is 235 feet.
- Line 575 to Ladysmith – This 500-kV line provides power to the Ladysmith Substation near Ladysmith, Virginia, east of NAPS. The overall length the corridor is nearly 15 miles; it contains only the Ladysmith line. The right-of-way width is 275 feet.
- Line 576 to Midlothian – Line 576 provides power at 500 kV to the Midlothian Substation, west of Richmond, Virginia. This southerly line runs approximately 41 miles, with the last 16 miles sharing the corridor with line 2009, a non-NAPS line. The right-of-way width is 235 feet.

In 1984, Dominion constructed the following fourth line to NAPS:

- Line 255 to South Anna – Line 255 provides power at 230 kV to a substation at South Anna, a non-utility generator. This westerly line runs approximately 31 miles. The right-of-way width varies from 100 to 120 feet and contains only the South Anna line.

Therefore, NAPS, currently has three 500-kV lines and one 230-kV line connecting the plant to the grid.

In total, for the specific purpose of connecting NAPS to the transmission system, Dominion has approximately 120 miles of transmission lines (120 miles of corridor) that occupy approximately 2,900 acres. Dominion plans to maintain these transmission lines, which are integral to the larger transmission system, indefinitely. They will remain a permanent part of the transmission system after NAPS is decommissioned, because these lines are critical links in the high voltage network. Also, the 230/500-kV transformer in the NAPS switchyard must remain in service to provide a strong 230-kV source for the region.

NAPS transmission line corridors pass through land that is primarily a mixture of cultivated land, grazing land, and managed timberlands (paper and pulp stock). Corridors that pass through farmlands generally continue to be used in this fashion. Corridors in timberlands and in the vicinity of road crossings are maintained on a 3-year cycle by mowing or, if inaccessible to mowers, by use of nonrestricted-use herbicides.

Dominion designed all NAPS 500 kV-transmission lines in accordance with the 1961 edition of the National Electrical Safety Code® and industry guidance that was current when the lines were designed and built. The 230-kV line to South Anna was designed in accordance with the 1981 edition of the Code. Ongoing right-of-way surveillance and maintenance of NAPS transmission facilities include routine aerial patrol, helicopter inspection, and ground inspection to ensure continued conformance to applicable standards. Routine aerial patrols of some corridors are conducted annually and include checks for encroachments, broken conductors, broken or leaning structures, and signs of excessive vegetation growth, any of which would be evidence of clearance problems. Slow helicopter inspections are conducted to allow more careful checks of facilities and rights-of-way as part of the three-year inspection cycle. Once every three years, all lines are inspected from the ground and measured for clearance at questionable locations. Problems noted during any inspection are brought to the attention of the appropriate organizations for corrective action.

3.2 Refurbishment Activities

NRC Input

"… The report must contain a description of … the applicant's plans to modify the facility or its administrative control procedures…. This report must describe in detail the modifications directly affecting the environment or affecting plant effluents that affect the environment…." 10 CFR 51.53(c)(2)

"… The incremental aging management activities carried out to allow operation of a nuclear power plant beyond the original 40-year license term will be from one of two broad categories: (1) SMITTR actions, most of which are repeated at regular intervals, and (2) major refurbishment or replacement actions, which usually occur fairly infrequently and possibly only once in the life of the plant for any given item…." (Ref. 3.1-2, Section 2.6.3.1, pg. 2-41). ("SMITTR" defined at GEIS Section 2.4, pp. 2-29-30, as enhanced surveillance, on-line monitoring, inspections, testing, trending, and recordkeeping.)

Dominion has addressed refurbishment activities in this environmental report in accordance with NRC regulations and complementary information in the NRC GEIS for license renewal (Ref. 3.1-2, Section 2.6.2). NRC requirements for the renewal of operating licenses for nuclear power plants include the preparation of an integrated plant assessment (IPA) (10 CFR 54). The IPA must identify and list structures, systems, and components (SSCs) subject to an aging management review. SSCs that are subject to aging and might require refurbishment include, for example, the reactor vessel, piping, supports, and pump casings (see 10 CFR 54.21 for details) that are not subject to replacement periodically.

In turn, the NRC regulations for implementing the National Environmental Policy Act require environmental reports to describe in detail and assess the environmental impacts of refurbishment activities such as planned modifications to SSCs or plant effluents [10 CFR 51.53(c)(2)]. Resource categories to be evaluated for impacts of refurbishment include terrestrial resources, threatened and endangered species, air quality, housing, public utilities and water supply, education, land use, transportation, and historic and archaeological resources.

The GEIS (Ref. 3.1-2) identifies major refurbishment activities that utilities might perform for license renewal. Performing such major refurbishment activities would necessitate changing administrative control procedures and modifying the facility. The GEIS analysis assumed that an applicant would begin any major refurbishment work shortly after NRC granted a renewed license and would complete the activities during five outages, including one major outage at the end of the 40th year of operation. The GEIS refers to this as the refurbishment period. GEIS Table B.2 lists license renewal refurbishment activities that NRC anticipated utilities might undertake. In identifying these activities, the GEIS intended to encompass actions that typically take place only once in the life of a nuclear plant, if at all. The GEIS analysis assumed that a utility would undertake these activities solely for the purpose of extending

plant operations beyond 40 years, and would undertake them during the refurbishment period. The GEIS indicates that many plants will have undertaken various major refurbishment activities to support the current license period, but that some plants might undertake such tasks only to support extended plant operations.

Dominion has performed some major construction activities at NAPS (e.g., steam generator replacement). However, the NAPS IPA that Dominion conducted under 10 CFR 54 has not identified the need to undertake any major refurbishment or replacement actions to maintain the functionality of important SSCs during the NAPS license renewal period. Dominion has included the IPA as part of this application.

3.3 Programs and Activities for Managing the Effects of Aging

NRC Input

".The report must contain a description of .the applicant's plans to modify the facility or its administrative control procedures....This report must describe in detail the modifications directly affecting the environment or affecting plant effluents that affect the environment...". 10 CFR 51.53(c)(2)

".The incremental aging management activities carried out to allow operation of a nuclear power plant beyond the original 40-year license term will be from one of two broad categories: (1) SMITTR actions, most of which are repeated at regular intervals, and (2) refurbishment or replacement actions, which usually occur fairly infrequently and possibly only once in the life of the plant for any given item...". Ref. 3.1-3, Section 2.6.3.1. (SMITTR is defined in Ref. 3.1-3, Section 2.4, as surveillance, monitoring, inspection, testing, trending, and recordkeeping.)

Appendix B of the license application contains a summary description of the programs and activities for managing the effects of NAPS aging. In addition to describing existing programs, Appendix B describes proposed modifications (enhancements) to existing programs and proposed new programs and activities. Dominion expects no modifications to the plant facility.

3.4 Employment

Current Workforce

Dominion employs a permanent workforce for both Units 1 and 2 of approximately 851 employees, with an additional 70 to 110 contract and matrixed employees at NAPS, which is less than the range of 600 to 800 personnel per reactor unit estimated in the GEIS (Ref. 3.1-2, Section 2.3.8.1). Approximately 73 percent of the employees live in Henrico, Louisa, Orange, and Spotsylvania Counties, with the balance of employees living in various other locations. Figure 2-5 shows the locations of these counties.

Dominion refuels each NAPS nuclear unit on an 18-month staggered schedule, which means at least one refueling every year and two refuelings every other year. During refueling outages, site employment increases above the 851 permanent workforce by as many as 700 workers for temporary (30 to 40 days) duty. This number is within the GEIS range of 200 to 900 additional workers per reactor outage.

License Renewal Increment

Performing the license renewal activities described in Section 3.3 would necessitate increasing NAPS staff workload by some increment. The size of this increment would be a function of the schedule within which Dominion must accomplish the work and the amount of work involved.

The GEIS (Ref. 3.1-2, Section 2.6.2.7) assumes that NRC would renew a nuclear power plant license for a 20-year period, plus the duration remaining on the current license, and that NRC would issue the renewal approximately 10 years prior to license expiration. In other words, the renewed license would be in effect for approximately 30 years. The GEIS further assumes that the utility would initiate surveillance, monitoring, inspection, testing, trending, and recordkeeping (SMITTR) activities at the time of issuance of the new license and would conduct license renewal SMITTR activities throughout the remaining 30-year life of the plant, sometimes during full-power operation (Ref. 3.1-2, Section B.3.1.3), but mostly during normal refueling and 10-year in-service refueling outages (Ref. 3.1-2, Table B.4).

Dominion has determined that the GEIS scheduling assumptions are reasonably representative of NAPS incremental license renewal workload scheduling. Many NAPS license renewal SMITTR activities would have to be performed during outages. Although some NAPS license renewal SMITTR activities would be one-time efforts, others would be recurring periodic activities that would continue for the life of the plant.

The GEIS estimates that the most additional personnel needed to perform license renewal SMITTR activities would typically be 60 persons during a 10-year in-service refueling. Having established this upper value for what would be a single event in 20 years, the GEIS

uses this number as the expected number of additional permanent workers needed per unit attributable to license renewal. GEIS Section C.3.1.2 uses this approach in order to "...provide a realistic upper bound to potential population-driven impacts…."

Dominion expects that existing "surge" capabilities for routine activities, such as outages, will enable Dominion to perform the increased SMITTR workload without adding NAPS staff. For the purpose of performing its own analyses in this environmental report, Dominion is adopting the GEIS approach with one alteration. Plant modifications during license renewal would be SMITTR activities that would be performed mostly during outages, and Dominion would generally stagger NAPS outage schedules so that both units would not be down at the same time. No plant facility modifications are anticipated. Therefore, Dominion believes that it is unreasonable to assume that each unit would need an additional 60 workers. Instead, as a reasonably conservative high estimate, Dominion is assuming that NAPS would require no more than a total of 60 additional permanent workers to perform all license renewal SMITTR activities.

Adding full-time employees to the plant workforce for the license renewal operating term would have the indirect effect of creating additional jobs and related population growth in the community. Dominion has used a Commonwealth of Virginia regional employment multiplier (4.7204) (Ref. 3.4-1) to calculate the total direct and indirect jobs in service industries that would be supported by the spending of the NAPS workforce. The addition of 60 employees during the license renewal period would generate approximately 283 indirect jobs distributed in the potentially impacted counties of Henrico, Louisa, Orange, and Spotsylvania. This number was calculated as follows: 60 (additional employees) x 4.7204 (regional multiplier) = 283 (total employees). Of these, 60 would be direct employees and 223 would be indirect.

3.5 North Anna Hydroelectric Project

The North Anna Hydroelectric Project is a small hydroelectric power plant of 855-kilowatt capacity owned and operated by Dominion, located in Louisa County, Virginia, on the North Anna River at the base of the North Anna Dam (Figure 3-2; Ref. 3.5-1). The hydroelectric facility consists of two separate generating units (Units 5A and 5B), each unit possessing a single stage, open runner-type ver t ical water turbine. An induction-type generator is mounted on top of each unit's turbine support column. Peak operational efficiency is at a flow of 40 cfs for Unit 5A and 133 cfs for Unit 5B. The control console for Units 5A and 5B is housed in a switchgear building approximately 500 feet southeast of the Dam. Generated power is connected through switches and transformers to an existing 12.5-kV line owned and operated by Rappahannock Electric Cooperative.

[picture not include]
North Anna Hydroelectric Project

Water for the hydroelectric facility is withdrawn from near the surface of Lake Anna (depth <7 feet). It comes through a skimmer gate and associated sluice pipe that is connected to a 5-foot diameter penstock. Water is then directed through 24- and 48-inch conduits to Units 5A and 5B, respectively, by a bifurcation piece. Flow through each conduit is controlled by inlet valves. After passing through the turbines, water is discharged into the North Anna River just downstream of the Dam spillway. The Commonwealth of Virginia requires a 40-cubic-foot-per-second (cfs) minimum discharge of water from the North Anna Dam unless drought conditions occur. These minimum flow requirements are established to maintain instream flows and water quality in the North Anna River below the dam and in the Pamunkey and York Rivers, which are further downstream. Should drought conditions exist and Lake Anna surface water levels reach 248 feet above msl, Dominion will begin reducing releases below the 40 cfs level in accordance with the Lake Level Contingency Plan as stipulated in Part I.F of the VPDES Permit (Ref. 3.5-2).

[picture not included]
North Anna Hydroelectric Project

An Exemption From Licensing (Ref. 3.5-1) was filed with the Federal Energy Regulatory Commission (FERC) in March 1984; an order granting the exemption was issued in September 1984. As part of the exemption from licensing by FERC, the U.S. Fish and

Wildlife Service requested that Dominion perform pre-operational and operational fish passage studies to evaluate the need for intake screening. Studies were conducted in 1986, 1987, and 1988 (Ref. 3.5-3). Results of these studies indicated that the number of fish passing from Lake Anna to the North Anna River was minimal (Ref. 3.5-4).

[picture not included] North Anna River below Dam

TABLES AND FIGURES

Table 3-1
NAPS Groundwater Use

	Water Use (in: Millions of Gallons)								
Month	1991	1992	1993	1994	1995	1996	1997	1998	1999
January	1.11	1.12	1.11	1.35	0.53	0.51	0.62	1.33	1.41
February	1.48	1.14	1.21	1.53	0.66	0.65	0.70	1.10	1.31
March	0.96	1.08	0.71	1.83	0.67	0.62	0.75	1.16	1.32
April	0.83	0.95	0.47	1.15	0.92	0.61	0.73	1.40	1.48
May	0.77	0.95	0.59	1.11	0.88	1.06	1.06	1.32	1.33
June	0.72	0.78	1.05	1.10	0.51	0.43	0.83	1.08	1.38
July	0.83	0.77	0.76	0.74	0.35	0.47	0.85	1.11	1.49
August	0.87	0.82	0.82	0.74	0.45	0.71	1.09	1.30	1.42
September	0.92	0.73	0.96	0.99	0.31	0.75	0.86	1.44	1.53
October	0.91	0.62	1.10	0.77	0.34	0.77	1.10	1.57	1.54
November	0.88	0.73	1.20	0.44	0.31	0.57	0.95	1.25	1.37
December	1.04	0.77	1.20	1.48	0.68	0.54	1.15	1.33	1.57
Yearly Total	11.32	10.46	11.18	13.23	6.61	7.69	10.69	15.39	17.15
Monthly Average	0.94	0.87	0.93	1.10	0.55	0.64	0.89	1.28	1.43

Reference: Ref. 3.1-7.

Figure 3-1
Dominion - North Anna Power Units 1 & 2 Detail Map

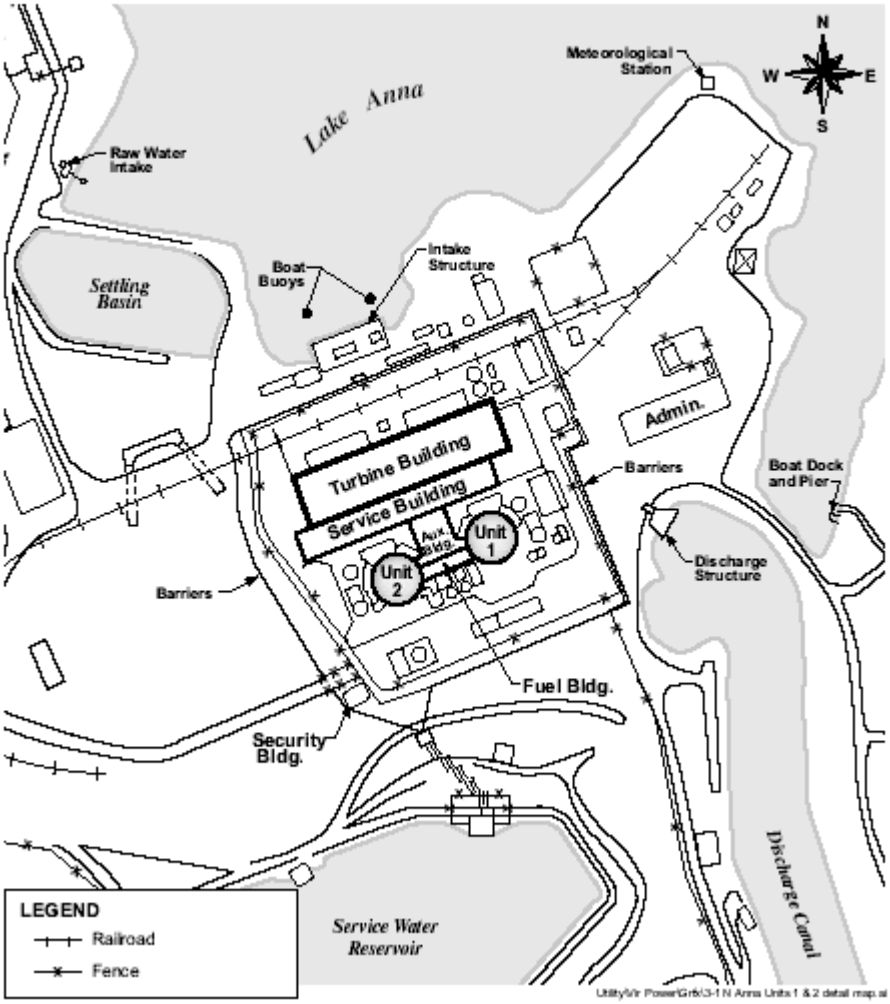
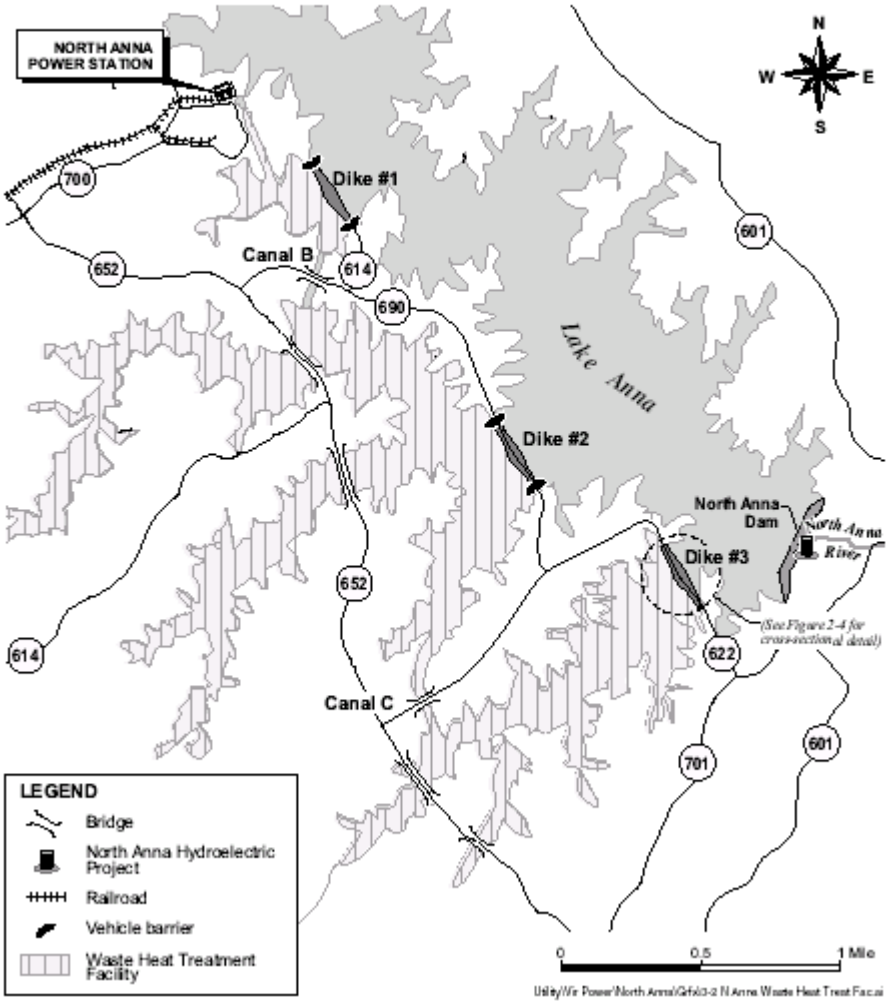


Figure 3-2
North Anna Power Station, Waste Heat Treatment Facility
Detail Vicinity Map



3.6 References

Ref. 3.1-1 U.S. Atomic Energy Commission. 1973. *Final Environmental Statement related to the continuation of construction and the operation of Units 1 & 2 and the construction of Units 3 & 4. North Anna Power Station*. Virginia Electric and Power Company. Docket Nos. 50-338 & 50-339; Docket Nos. 50-404 & 50-405. Directorate of Licensing. Washington, DC.

Ref. 3.1-2 U.S. Nuclear Regulatory Commission. 1996. *Generic Environmental Impact Statement for License Renewal of Nuclear Plants* (GEIS). Volumes 1 and 2. NUREG-1437. Washington, DC.

Ref. 3.1-3 Virginia Power. 1999. *North Anna Updated Final Safety Analysis Report*. Rev. 34. Updated online August 27.

Ref. 3.1-4 U.S. Nuclear Regulatory Commission. 1986. "Virginia Electric and Power Co. and Old Dominion Electric Cooperative, North Anna Power Station, Units 1 and 2; Environmental Assessment and Finding of No Significant Impact." *Federal Register* 51, No. 154.

Ref. 3.1-5 Virginia Power. 2000. "Virginia Power Generating Stations." Available at http://www.vapower.com/news/ information/stations.html. Accessed February 21, 2000.

Ref. 3.1-6 Virginia Electric and Power Company. 1986. *Section 316(a) Demonstration for North Anna Power Station: Environmental Studies of Lake Anna and the Lower North Anna River*. Submitted to Virginia State Water Control Board.

Ref. 3.1-7 Virginia Power. NAPS Waterworks Operation Permit (January 15, 1998) and water analysis reports, 1991 - 1999.

Ref. 3.1-8 Virginia Power. 1976. *Appendix L - Update to Virginia Electric and Power Company Applicant's Environmental Report, Operating License Stage: North Anna Power Station Units 1 and 2.* Docket Nos. 50-338 and 50-339. Richmond, VA.

Ref. 3.4-1 U.S. Department of Commerce. Economics and Statistics Administration. Bureau of Economic Analysis. 1992. "Regional Multipliers: A User Handbook for the Regional Input-Output Modeling System (RIMS II)." Washington, DC.

Ref. 3.5-1 U.S. Federal Energy Regulatory Commission. 1984. *Order Granting Exemption from Licensing of a Small Hydroelectric Project of 5 Megawatts or less to Virginia Electric and Power Company*. Project No. 6335-001.

Washington, DC. September 6.

Ref. 3.5-2 Commonwealth of Virginia. 2001. Department of Environmental Quality. Permit No. VA0052451. *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*.

Ref. 3.5-3 Commonwealth of Virginia. 1997. Department of Environmental Quality. *North Anna Power Station: Amended Virginia Pollutant Discharge Elimination System Permit.* Modified November 18.

Ref. 3.5-4 Virginia Power. 1989. "Fish Passage Study for Lake Anna Dam, 1986 - 1988." Corporate Technical Services, Water Quality Section. Richmond, VA.

4.0 ENVIRONMENTAL CONSEQUENCES OF THE PROPOSED ACTION AND MITIGATING ACTIONS

NRC Input

"The environmental report shall include an analysis that considers...the environmental effects of the proposed action...and alternatives available for reducing or avoiding adverse environmental effects." 10 CFR 51.53(c)

"The environmental report shall discuss the "...impact of the proposed action on the environment. Impacts shall be discussed in proportion to their significance...." 10 CFR.51 45(b)(1) as adopted by 10 CFR 51.53(c)(2)

Chapter 4 presents an assessment of the environmental consequences and potential mitigating actions associated with the renewal of North Anna Power Station's Units 1 & 2 (NAPS) operating licenses. The U.S. Nuclear Regulatory Commission (NRC) has identified and analyzed 92 environmental issues that it considers associated with nuclear power plant license renewal and has designated the issues as Category 1, Category 2, or NA (not applicable) (Ref. 4.0-1). NRC has designated the issues as Category 1 if, after analysis, the following criteria were met:

- the environmental impacts associated with the issue have been determined to apply either to all plants or, for some issues, to plants having a specific type of cooling system or other specified plant or site characteristic;
- a single significance level (i.e., small, moderate, or large) has been assigned to the impacts that would occur at any plant, regardless of which plant is being evaluated (except for collective offsite radiological impacts from the fuel cycle and from high-level waste and spent-fuel disposal); and
- mitigation of adverse impacts associated with the issue has been considered in the analysis, and it has been determined that additional plant-specific mitigation measures are likely to be not sufficiently beneficial to warrant implementation.

North Anna Power Station	
Category 1 issues not applicable[a]	19
Category 1 issues applicable	50
NA[b] Issues	2
Category 2 issues not applicable	9
Category 2 issues applicable	12

a. Not applicable to North Anna because they pertain to design or operational features that North Anna does not have.
b. Categorization and impact definitions do not apply.

If the NRC analysis concluded that one or more of the Category 1 criteria could not be met, NRC designated the issue as Category 2. NRC requires plant-specific analysis for Category 2 issues. NRC designated two issues as NA, signifying that the categorization and impact definitions do not apply to these issues. NRC rules do not require analyses of Category 1 issues that NRC has resolved using generic findings (10 CFR 51, Appendix B, Table B-1) in the *Generic Environmental Impact Statement for License Renewal of Nuclear Plants* (GEIS) (Ref. 4.0-1). An applicant may reference the generic findings or GEIS analyses for Category 1 issues. Appendix A lists the 92 issues and identifies the environmental report section that addresses each issue.

Category 1 License Renewal Issues

NRC Input

"...The environmental report for the operating license renewal stage is not required to contain analyses of the environmental impacts of the license renewal issues identified as Category 1 issues in Appendix B to subpart A of this part." 10 CFR 51.53(c)(3)(i)

"...[A]bsent new and significant information, the analysis for certain impacts codified by this rulemaking need only be incorporated by reference in an applicant's environmental report for license renewal...." Discussion of Regulatory Requirements, (Ref. 4.0-2, pg. 28483).

Dominion has determined that, of the 69 Category 1 issues, 12 do not apply to NAPS because they apply to design or operational features that do not exist at the facility. These features include cooling towers, cooling water discharges in coastal areas, and cooling ponds in coastal areas. In addition, because Dominion does not plan to conduct any refurbishment activities, the NRC findings for the seven Category 1 issues that apply only to refurbishment do not apply. Table 4-1 lists these 19 issues and explains Dominion's basis for determining that these issues are not applicable to NAPS.

Table 4-2 lists the 50 Category 1 issues that Dominion has determined to be applicable to NAPS, as well as the two issues for which NRC came to no generic conclusion (NA Issues 60 and 92). The table includes findings that NRC codified and references to supporting GEIS analyses. Dominion has reviewed the NRC findings and identified no new and significant information, nor has Dominion become aware of any information that would make the NRC findings inapplicable to NAPS. Therefore, Dominion adopts by reference the NRC findings for these Category 1 issues.

Category 2 License Renewal Issues

NRC Input

"...The environmental report must contain analyses of the environmental impacts of the proposed action, including the impacts of refurbishment activities, if any, associated with license renewal and the impacts of operation during the renewal term, for those issues identified as Category 2 issues in Appendix B to subpart A of this part...." 10 CFR 51.53(c)(3)(ii)

"The report must contain a consideration of alternatives for reducing adverse impacts, as required by § 51.45(c), for all Category 2 license renewal issues...." 10 CFR 51.53(c)(3)(iii)

NRC designated 21 issues as Category 2. Sections 4.1 through 4.20 address each of the Category 2 issues, beginning with a statement of the issue. As with the Category 1 issues, some Category 2 issues (five) apply to design or operational features that NAPS does not have. In addition, some Category 2 issues (four) apply only to refurbishment activities. If the issue does not apply to NAPS, the section explains the basis for inapplicability.

For the 12 Category 2 issues that Dominion has determined to be applicable to NAPS, the sections contain required analyses. These analyses include conclusions regarding the significance of the impacts relative to renewal of the operating licenses for NAPS and discuss potential mitigative alternatives, when applicable, and to the extent required. Dominion has identified the significance of the impacts associated with each issue as either small, moderate, or large, consistent with the criteria that NRC established in 10 CFR 51, Appendix B, Table B-1, Footnote 3 as follows:

Small - Environmental effects are not detectable or are so minor that they will neither destabilize nor noticeably alter any important attribute of the resource. For the purposes of assessing radiological impacts, the Commission has concluded that those impacts that do not exceed permissible levels in the Commission's regulations are considered small.

Moderate - Environmental effects are sufficient to alter noticeably, but not to destabilize, any important attribute of the resource.

Large - Environmental effects are clearly noticeable and are sufficient to destabilize any important attributes of the resource.
In accordance with National Environmental Policy Act (NEPA) practice, Dominion considered ongoing and potential additional mitigation in proportion to the significance of the impact to be addressed (e.g., impacts that are small receive less mitigative consideration than impacts that are large).

NA License Renewal Issues

NRC determined that its categorization and impact finding definitions did not apply (NA = not applicable) to Issues 60 and 92. Dominion included these issues in Table 4-2. NRC noted that applicants currently do not need to submit information on chronic effects from electromagnetic fields (10 CFR 51, Appendix B, Table B-1, Footnote 5). For the other NA issue, environmental justice, NRC did not require information from applicants, but noted that it will be addressed in individual license renewal reviews (10 CFR 51, Appendix B, Table B-1, Footnote 6). Dominion has included environmental justice demographic information in Section 2.11.

4.1 Water Use Conflicts (Plants with Cooling Ponds or Cooling Towers Using Makeup Water from a Small River with Low Flow)

NRC Input

"If the applicant's plant utilizes cooling towers or cooling ponds and withdraws make-up water from a river whose annual flow rate is less than 3.15×10^{12} ft^3/year (9×10^{10} m^3/year), an assessment of the impact of the proposed action on the flow of the river and related impacts on instream and riparian ecological communities must be provided. The applicant shall also provide an assessment of the impacts of the withdrawal of water from the river on alluvial aquifers during low flow." 10 CFR 51.53(c)(3)(ii)(A)

"The issue has been a concern at nuclear power plants with cooling ponds and at plants with cooling towers. Impacts on instream and riparian communities near these plants could be of moderate significance in some situations." 10 CFR 51, Subpart A, Appendix B, Table B-1, Issue 13

This issue does not apply to NAPS because the plant does not utilize cooling towers or cooling ponds. As Section 3.1.2 describes, NAPS uses a once-through cooling system and a specialized Waste Heat Treatment Facility (WHTF) to dissipate waste heat.

4.2 Entrainment of Fish and Shellfish In Early Life Stages

NRC Input

"If the applicant's plant utilizes once-through cooling or cooling pond heat dissipation systems, the applicant shall provide a copy of current Clean Water Act 316(b) determinations...or equivalent State permits and supporting documentation. If the applicant cannot provide these documents, it shall assess the impact of the proposed action on fish and shellfish resources resulting from...entrainment." 10 CFR 51.53(c)(3)(ii)(B)

"...The impacts of entrainment are small in early life stages at many plants but may be moderate or even large at a few plants with once-through and cooling-pond cooling systems. Further, ongoing efforts in the vicinity of these plants to restore fish populations may increase the numbers of fish susceptible to intake effects during the license renewal period, such that entrainment studies conducted in support of the original license may no longer be valid..." 10 CFR 51, Subpart A, Appendix B, Table B-1, Issue 25

NRC made impacts on fish and shellfish resources resulting from entrainment a Category 2 issue because it could not assign a single significance level (small, moderate, or large) to the issue. The impacts of entrainment are small at many plants, but they may be moderate or large at others. Also, ongoing restoration efforts may increase the number of fish susceptible to intake effects during the license renewal period (Ref. 4.0-1, Section 4.2.2.1.2). Information to be ascertained includes: (1) type of cooling system (whether once-through or cooling pond), and (2) current Clean Water Act (CWA) Section 316(b) determination or equivalent state documentation.

As Section 3.1.2 describes, NAPS has a once-through heat dissipation system. As described below, Dominion also has state documentation equivalent to a Section 316(b) determination.

Section 316(b) of the CWA requires that any standard established pursuant to Sections 301 or 306 of the CWA shall require that the location, design, construction, and capacity of cooling water intake structures reflect the best technology available for minimizing adverse environmental impacts (33 USC 1326). Entrainment through the condenser cooling system of fish and shellfish in the early life stages is one of the adverse environmental impacts that the best technology available minimizes. Virginia State Water Control Board regulations provide that compliance with a Virginia Pollutant Discharge Elimination System (VPDES) permit constitutes compliance with Sections 301 and 306 of the CWA (Ref. 4.2-1). In response to Board requirements, Dominion submitted a CWA Section 316(b) demonstration for NAPS in May 1985 (Ref. 4.2-2). Based on this and other input, the Board issued the NAPS VPDES permit (Appendix B). Issuance of the NAPS VPDES permit indicates the Board's conclusion that NAPS, in operating in conformance with the permit, would be in compliance with the CWA requirements. Dominion concludes that the Commonwealth

regulation and the NAPS VPDES permit constitute the NAPS CWA 316(b) determination. Dominion also concludes that any environmental impact from entrainment of fish and shellfish in early life stages is small and does not require further mitigation.

4.3 Impingement of Fish and Shellfish

NRC Input

"If the applicant's plant utilizes once-through cooling or cooling pond heat dissipation systems, the applicant shall provide a copy of current Clean Water Act 316(b) determinations...or equivalent State permits and supporting documentation. If the applicant can not provide these documents, it shall assess the impact of the proposed action on fish and shellfish resources resulting from...impingement...." 10 CFR 51.53(c)(3)(ii)(B)

"...The impacts of impingement are small at many plants but may be moderate or even large at a few plants with once-through and cooling-pond cooling systems...." 10 CFR 51, Subpart A, Appendix B, Table B-1, Issue 26

NRC made impacts on fish and shellfish resources resulting from impingement a Category 2 issue because it could not assign a single significance level to the issue. Impingement impacts are small at many plants, but might be moderate or large at other plants (Ref. 4.0-1, Section 4.2.2.1.3). Information to be ascertained includes: (1) type of cooling system (whether once-through or cooling pond), and (2) current CWA 316(b) determination or equivalent state documentation.

As Section 3.1.2 describes, NAPS has a once-through heat dissipation system. Section 4.2 discusses the CWA 316(b) demonstration for NAPS, indicating compliance with the use of best available technology. Section 2.5 also states that no federally- or state-listed fish species have been collected in any monitoring studies, nor has any listed species been observed in creel surveys conducted by Dominion biologists and affiliated researchers. Based on the results of the CWA 316(b) Demonstration, Dominion concludes that this environmental impact is small and does not require further mitigation.

4.4 Heat Shock

NRC Input

"If the applicant's plant utilizes once-through cooling or cooling pond heat dissipation systems, the applicant shall provide a copy of current Clean Water Act... 316(a) variance in accordance with 40 CFR 125, or equivalent State permits and supporting documentation. If the applicant cannot provide these documents, it shall assess the impact of the proposed action on fish and shellfish resources resulting from heat shock ...." 10 CFR 51.53(c)(3)(ii)(B)

"...Because of continuing concerns about heat shock and the possible need to modify thermal discharges in response to changing environmental conditions, the impacts may be of moderate or large significance at some plants...." 10 CFR 51, Subpart A, Appendix B, Table B-1, Issue 27

NRC made impacts on fish and shellfish resources resulting from heat shock a Category 2 issue, because of continuing concerns about thermal discharge effects and the possible need to modify thermal discharges in the future in response to changing environmental conditions (Ref. 4.0-1, Section 4.2.2.1.4). Information to be ascertained includes: (1) type of cooling system (whether once-through or cooling pond), and (2) evidence of a CWA Section 316(a) variance or equivalent state documentation.

As Section 3.1.2 describes, NAPS has a once-through heat dissipation system. As discussed below, Dominion has a Section 316(a) variance for NAPS discharges. Section 316(a) of the CWA establishes a process whereby a thermal effluent discharger can demonstrate that thermal discharge limitations are more stringent than necessary and, using a variance, obtain alternative facility-specific thermal discharge limits (33 USC 1326).

Dominion submitted a CWA Section 316(a) Demonstration for NAPS to the Virginia State Water Control Board on June 24,1986 (Ref. 4.4-1). The Fact Sheet (Item 22) accompanying the current NAPS VPDES permit (Appendix B) refers to this submittal, indicating that effluent limitations more stringent than the thermal limitations included in the permit are not necessary to assure the protection and propagation of a balanced indigenous community of shellfish, fish, and wildlife in Lake Anna and in the North Anna River downstream of the Lake.

Based on the results of the CWA Section 316(a) Demonstration and the NAPS VPDES permit, Dominion concludes that this environmental impact is small and does not warrant further mitigation.

4.5 Groundwater Use Conflicts (Plants that use > 100 gpm)

NRC Input

"If the applicant's plant...pumps more than 100 gallons (total onsite) of groundwater per minute, an assessment of the impact of the proposed action on groundwater use must be provided." 10 CFR 51.53(c)(3)(ii)(C)

"Plants that use more than 100 gpm may cause groundwater use conflicts with nearby groundwater users." 10 CFR 51, Subpart A, Appendix B, Table B-1, Issue 33

Based on information presented in Section 3.1.2.2, NAPS groundwater use is less than 100 gallons per minute (gpm). Therefore, the issue of groundwater use conflicts does not apply.

4.6 Groundwater Use Conflicts (Plants Using Cooling Towers Withdrawing Makeup Water from a Small River)

NRC Input

"... If the applicant's plant utilizes cooling towers or cooling ponds and withdraws makeup water from a river whose annual flow rate is less than 3.15×10^{12} ft^3/year.... [The] applicant shall also provide an assessment of the impact of the withdrawal of water from the river on alluvial aquifers during low flow." 10 CFR 51.53(c)(3)(ii)(A)

"Water use conflicts may result from surface water withdrawals from small water bodies during low flow conditions which may affect aquifer recharge, especially if other groundwater or upstream surface water users come on line before the time of license renewal." 10 CFR 51, Subpart A, Appendix B, Table B-1, Issue 34

The issue of groundwater use conflicts does not apply to NAPS because the plant does not use cooling ponds or cooling towers. As Section 3.1.2 describes, NAPS uses a once-through cooling system.

4.7 Groundwater Use Conflicts (Plants Using Ranney Wells)

NRC Input

"...If the applicant's plant uses Ranney wells...an assessment of the impact of the proposed action on groundwater use must be provided...." 10 CFR 51.53(c)(3)(ii)(C)

"... Ranney wells can result in potential groundwater depression beyond the site boundary. Impacts of large groundwater withdrawal for cooling tower makeup at nuclear power plants using Ranney wells must be evaluated at the time of application for license renewal...." 10 CFR 51, Subpart A, Appendix B, Table B-1, Issue 35

The issue of groundwater use conflicts does not apply to NAPS because the plant does not use Ranney wells. As Section 3.1.2 describes, NAPS uses a once-through cooling system.

4.8 Degradation of Groundwater Quality

NRC Input

"...If the applicant's plant is located at an inland site and utilizes cooling ponds...an assessment of the impact of the proposed action on groundwater quality must be provided...." 10 CFR 51.53(c)(3)(ii)(D)

"...Sites with closed cycle cooling ponds may degrade water groundwater quality. For plants located inland, the quality of the groundwater in the vicinity of the ponds must be shown to be adequate to allow continuation of current uses...." 10 CFR 51, Subpart A, Appendix B, Table B-1, Issue 39

The issue of groundwater degradation does not apply to NAPS because the plant does not use cooling ponds. As Section 3.1.2 describes, NAPS uses a once-through cooling system that withdraws water from Lake Anna and discharges it via the WHTF back to Lake Anna.

4.9 Impacts of Refurbishment on Terrestrial Resources

NRC Input

The environmental report must contain an assessment of "...the impacts of refurbishment and other license renewal-related construction activities on important plant and animal habitats...." 10 CFR 51.53(c)(3)(ii)(E)

"...Refurbishment impacts are insignificant if no loss of important plant and animal habitat occurs. However, it cannot be known whether important plant and animal communities may be affected until the specific proposal is presented with the license renewal application...." 10 CFR 51, Subpart A, Appendix B, Table B-1, Issue 40

"...If no important resources would be affected, the impacts would be considered minor and of small significance. If important resources could be affected by refurbishment activities, the impacts would be potentially significant...." Ref. 4.0-1, Section 3.6, pg. 3-6

NRC made impacts to terrestrial resources from refurbishment a Category 2 issue, because the significance of ecological impacts cannot be determined without considering site- and project-specific details (Ref. 4.0-1, Section 3.6). Aspects of the site project to be ascertained are: (1) the identification of important ecological resources, (2) the nature of refurbishment activities, and (3) the extent of impact to plant and animal habitats.

The issue of impacts of refurbishment on terrestrial resources is not applicable to NAPS because, as discussed in Section 3.2, Dominion has no plans for refurbishment or other license-renewal-related construction activities at NAPS.

4.10 Threatened or Endangered Species

NRC Input

"Additionally, the applicant shall assess the impact of the proposed action on threatened or endangered species in accordance with the Endangered Species Act." 10 CFR 51.53(c)(3)(ii)(E)

"Generally, plant refurbishment and continued operation are not expected to adversely affect threatened or endangered species. However, consultation with appropriate agencies would be needed at the time of license renewal to determine whether threatened or endangered species are present and whether they would be adversely affected." 10 CFR 51, Subpart A, Appendix B, Table B-1, Issue 49

NRC made impacts to threatened and endangered species a Category 2 issue, because the status of many species is being reviewed; site-specific assessment is required to determine whether any identified species could be affected by refurbishment activities or continued plant operations through the renewal period. In addition, compliance with the Endangered Species Act requires consultation with the appropriate federal agency (Ref. 4.0-1, Sections 3.9 and 4.1).

Section 2.2 of this Environmental Report describes the aquatic communities of Lake Anna and the North Anna River downstream of the North Anna Dam. Section 2.4 discusses terrestrial habitats at NAPS and along associated transmission lines. Section 2.5 discusses aquatic and terrestrial species that occur or may occur at NAPS and along associated transmission lines and that have special status (e.g., threatened, endangered, or State special concern).

Because no threatened or endangered aquatic species were historically found or are now found in Lake Anna, the operation of NAPS (withdrawal and discharge of cooling water) is not expected to affect any listed aquatic species. Threatened and endangered aquatic species could, in theory, be found in water bodies (streams, ponds, and wetlands) crossed by NAPS transmission line corridors, although none have been observed or identified as actually being present along the lines. Dominion i s planning no refurbishment or other license-renewal-related construction activities and is not aware of any NAPS operational or maintenance practices that could affect aquatic species in these water bodies. Therefore, consistent with 10 CFR 51, Dominion has identified threatened and endangered species that might be present in transmission corridor water bodies (Section 2.5), and concludes that any such species would not be affected by continued operation of NAPS through the license renewal period.

Similarly, continued operations during the period of extended operations are not expected to have any adverse effect on threatened or endangered terrestrial species. The continued

operation of the plant is not expected to adversely affect any habitat and, in fact, Dominion takes steps to protect and enhance habitats along the transmission corridors. Operation of NAPS for more than 25 years has had a largely positive effect on terrestrial wildlife, including special-status species. For example, Lake Anna provides resting and foraging areas for large numbers of waterfowl and foraging habitat for the federally-listed bald eagle. As noted in Section 2.5, Dominion cooperates with VDCR's Natural Heritage Program in rare plant surveys within transmission line corridors and maintains inventories of rare or sensitive plant populations in transmission line corridors to ensure their protection. Although rare plant species have been found along Dominion transmission corridors in other parts of the state, no endangered or threatened plant species have been recorded along the transmission corridors associated with NAPS.

As discussed in Section 3.2, Dominion has no plans to conduct major refurbishment or construction at NAPS during the license renewal period. Therefore, there would be no refurbishment-related impacts to special status species, and no further analysis of refurbishment-related impacts is applicable. A positive impact would be realized by the continuation of habitat protection and enhancement programs related to transmission line rights-of-way supported by continued operation of NAPS.

On April 12, 2000, Dominion initiated correspondence with regulatory agencies concerning threatened and endangered species and is currently awaiting agency responses. See Section 9.1.2 for discussion of threatened and endangered species consultation and Appendix C for correspondence.

4.11 Air Quality During Refurbishment

NRC Input

"...If the applicant's plant is located in or near a nonattainment or maintenance area, an assessment of vehicle exhaust emissions anticipated at the time of peak refurbishment workforce must be provided in accordance with the Clean Air Act as amended...." 10 CFR 51.53(c)(3)(ii)(F)

"...Air quality impacts from plant refurbishment associated with license renewal are expected to be small. However, vehicle exhaust emissions could be cause for concern at locations in or near nonattainment or maintenance areas. The significance of the potential impact cannot be determined without considering the compliance status of each site and the numbers of workers expected to be employed during the outage...." 10 CFR 51, Subpart A, Appendix B, Table B-1, Issue 50

NRC made impacts to air quality during refurbishment a Category 2 issue, because vehicle exhaust emissions could be cause for some concern; a general conclusion about the significance of the potential impact could not be drawn without considering the compliance status of each site and the number of workers expected to be employed during the outage (Ref. 4.0-1, Section 3.3). Information needed would include: (1) the attainment status of plant-site area, and (2) the number of additional vehicles as a result of refurbishment activities.

Air quality during refurbishment is not applicable to NAPS because, as discussed in Section 3.2, Dominion has no plans for refurbishment at NAPS.

4.12 Microbiological Organisms

NRC Input

"If the applicant's plant uses a cooling pond, lake, or canal or discharges into a river having an annual average flow of less than $3.15 \times 10^{12} ft^3$/year ($9 \times 10^{10} m^3$/year), an assessment of the proposed action on public health from thermophilic organisms in the affected water must be provided." 10 CFR 51.53(c)(3)(ii)(G)

"These organisms are not expected to be a problem at most operating plants except possibly at plants using cooling ponds, lakes, or canals that discharge to small rivers. Without site-specific data, it is not possible to predict the effects generically." 10 CFR 51, Subpart A, Appendix B, Table B-1, Issue 57

NRC designated impacts on public health from thermophilic organisms a Category 2 issue because the magnitude of the potential public health impacts associated with thermal enhancement of *Naegleria fowleri* could not be determined generically. NRC noted in the GEIS that impacts of nuclear plant cooling towers and thermal discharges are considered to be of small significance, if they do not enhance the presence of microorganisms that are detrimental to water quality and public health (Ref. 4.0-1, Section 4.3.6). Information to be evaluated includes: (1) thermal discharge temperature, (2) thermal characteristics of Lake Anna and the North Anna River, (3) thermal conditions for the enhancement of *N. fowleri* and other pathogens, and (4) potential impacts to public health.

This issue is applicable to NAPS because NAPS discharges to the North Anna River, which is categorized as a small river in the GEIS (Ref. 4.0-1, Section 5.3.3.4.2, Table 19). Before the creation of Lake Anna, average annual flow in the North Anna River at a gaging station near Doswell was 1.17×10^{10} cubic feet per year (Ref. 4.12-1, Section 2.5.2). Also, there is public access to the river, Lake Anna (which ultimately receives effluent cooling water), and the WHTF that includes recreational boating, fishing, and residential housing along these waterbodies. Access to the WHTF is limited to private homeowners with private boat launches. Organisms of concern include the enteric pathogens *Salmonella* and *Shigella*, the *Pseudomonas aeruginosa* bacterium, thermophilic Actinomycetes "fungi," the many species of *Legiionella* bacteria, and pathogenic strains of the free-living *Naegleria* amoeba.

The Virginia State Water Control Board and Virginia Department of Environmental Quality have not set state standards for any of these organisms. The only state water quality standard for microorganisms in the North Anna River and Lake Anna (which are classified by the Virginia State Water Control Board as Class III non-tidal waters) applies to fecal coliform bacteria, which are not to exceed a geometric mean of 200 organisms per 100 milliliters (for two or more samples over a 30-day period). Fecal coliform bacteria are used by many state

agencies, including the Commonwealth of Virginia, as indicators of other potentially harmful waterborne microorganisms.

R. J. Duma conducted a study of free-living pathogenic amoebas in nine lakes in the Richmond, Virginia, area (including NAPS's WHTF) from December 1976 to August 1979 (Ref. 4.12-2). Seven of the nine lakes were intensively sampled (bi-weekly). Pathogenic *Naegleria* fowleri were isolated from four of the seven intensively-sampled lakes, including the
WHTF at NAPS. Pathogenic *Naegleria* were isolated from the WHTF only after Unit 1 came online in June 1978. Dominion scientists postulated that the organism was present prior to plant operation, but that thermal enrichment probably increased population levels, making collection and isolation of organisms more likely.

As a result of the Duma study, Dominion environmental protection personnel met in 1981 with the State (Health Department) Epidemiologist, Dr. Grayson Miller, to determine if *Naegleria* in
the WHTF and Lake Anna represented a public health risk (Ref. 4.12-2). Dr. Miller in turn consulted with other state and federal agencies, including the Florida Department of Health, Centers for Disease Control, and U.S. Environmental Protection Agency. State and federal officials determined that the risk of contracting primary amoebic meningoencephalitis from *Naegleria* in the WHTF and Lake Anna was too low to justify any action by Dominion or state agencies (Ref. 4.12-2).

Thermophilic bacteria generally occur at temperatures of 77 to 176 degrees Fahrenheit (°F), with maximum growth at 122 to 140°F. Pathogenic bacteria have evolved to survive in the digestive tracts of mammals and, accordingly, have optimum temperatures of around 99°F (Ref. 4.12-3, pg. 65). Many of these pathogenic microorganisms (e.g., *Pseudomonas*, *Salmonella*, and *Shigella*) are ubiquitous in nature, occurring in the digestive tracts of wild mammals and birds (and thus in natural waters), but are usually only a problem when the host is immunologically compromised.

Dominion monitored water temperatures at seven Lake Anna stations from 1975 through 1985 as part of a CWA Section 316(a) Demonstration for NAPS (Ref. 4.4-1, Section 3.5, pg. 72). Temperatures were recorded hourly at most of these locations. Highest (hourly average) temperatures recorded in June, July, and August over this period were 91.8ºF (at an Upper Lake station in 1984), 92.7ºF (at an Upper Lake station in 1977), and 91.6ºF (at a Lower Lake station in 1980). The highest (hourly average) water temperature was measured on July 19, 1977, at the northern-most station (Pamunkey Creek arm) before NAPS began operating. The highest (hourly average) water temperature measured in an operational year was 92.3ºF, recorded in 1983 (Ref. 4.4-1, Section 3.5, pg. 74).

In addition, Dominion monitored water temperatures (reported as mean monthly values) in Lake Anna at a station near Dike 3, where the heated effluent from NAPS enters the reservoir

(Ref. 4.4-1, Section 3.5, p. 78). This monitoring also supported the Section 316(a) Demonstration for the NAPS and was conducted over a period from August 1983 through December 1985. Mean monthly effluent temperatures at Dike 3 ranged from 45.0ºF to 88.2ºF (Table 4-3). In all years evaluated, temperatures were highest in late summer (July and August), when thermal conditions are most optimal for growth and survival of thermophilic organisms.

Following the submission and acceptance in 1986 of the NAPS Section 316(a) Demonstration, Dominion continued monitoring Lake Anna and the North Anna River to ensure that biological resources were not harmed by ongoing station operations. As a part of this post-316(a) monitoring effort, Dominion also monitored temperatures in the NAPS discharge canal and WHTF. In 1997, the maximum water temperature recorded in Lake Anna was 86.4ºF (July) (Ref. 4.12-4, Table 3.1-1). The highest temperatures recorded in the NAPS discharge canal and WHTF in 1997 were 97.7ºF and 94.3ºF, respectively. The station operated at 97 percent of capacity during the summer of 1997.

NAPS discharge temperatures in summer are within the range of those known to permit the growth and reproduction of pathogenic microorganisms, but are below those considered optimal for thermophilic forms. Temperatures in the WHTF immediately downstream from the NAPS discharge structure are several degrees cooler than those in the immediate area of the discharge outfall and, under normal circumstances, would not therefore support the growth and reproduction of these pathogenic organisms. Temperatures in Lake Anna and the North Anna River below the dam are almost always too low to support populations of thermophilic pathogens.

Another factor limiting concentrations of pathogenic microorganisms in the NAPS discharge is the absence of a seed source or inoculant. Wastewater, whether domestic sewage or industrial wastewater, is usually the source of pathogens in natural waters. The sewage treatment facility at NAPS originally consisted of three small package secondary treatment plants. In 1997, these plants were consolidated into an existing 30,000 gallon-per-day extended aeration sewage treatment plant. Disinfection in the sewage treatment facility reduces coliform bacteria (and other microorganisms) to levels that meet state water quality standards. Discharge is regulated by VPDES Permit No. VA0052451.

In summary, based on the following factors, Dominion has not seen an increased risk to the public nor does Dominion expect the thermophilic organism *Naegleria fowleri* to be a public health problem at NAPS:

- field measurements show that discharge canal, WHTF, and Lake Anna water temperatures are below the optimum for growth of this organism

- NAPS, due to its wastewater disinfection practices, does not provide a seed source or inoculant that would stimulate population growth
- field sampling has detected this naturally-occurring organism, but not in numbers that would suggest a problem
- the Virginia State Epidemiologist has reviewed the data and conducted an independent evaluation, but has not required further action

Dominion concludes that the impact from *Naegleria fowleri* would be small and that mitigation beyond current wastewater treatment practices is not warranted.

4.13 Electric Shock From Transmission-Line-Induced Currents

NRC Input

The environmental report must contain an assessment of the impact of the proposed action on the potential shock hazard from transmission lines ". . . [i]f the applicant's transmission lines that were constructed for the specific purpose of connecting the plant to the transmission system do not meet the recommendations of the National Electric Safety Code for preventing electric shock from induced currents." 10 CFR 51.53(c)(3)(ii)(H)

"Electrical shock resulting from direct access to energized conductors or from induced charges in metallic structures have not been found to be a problem at most operating plants and generally are not expected to be a problem during the license renewal term. However, site-specific review is required to determine the significance of the electric shock potential at the site." 10 CFR 51, Subpart A, Appendix B, Table B-1, Issue 59

NRC made impacts of electric shock from transmission lines a Category 2 issue because, without a review of each plant's transmission line conformance with the National Electrical Safety Code® (NESC®) (Ref. 4.13-1) criteria, NRC could not determine the significance of the electric shock potential. The GEIS states that the transmission lines of concern are those between the plant switchyard and its connection with the existing transmission system (Ref. 4.0-1, Section 4.5, pg. 4-59).

The GEIS further stipulates that the analysis must ascertain: (1) change in line use and voltage since last analysis, (2) conformance with NESC® standards, and (3) potential change in land use along transmission lines since initial NEPA review. With respect to this NAPS analysis, there has been no NRC or NEPA analysis of the NAPS transmission lines' induced current hazard (although the transmission line designers took induced current into account in designing the lines). Therefore, this section addresses only the second analytical element: conformance with NESC® standards.

Objects located near transmission lines can become electrically charged due to the effect of what is commonly called "static electricity," but is more precisely termed "an electrostatic field." This charge results in a current that flows through the object to the ground. The current is called "induced" because there is no direct connection between the line and the object. The induced current can also flow to the ground through the body of a person who touches the object. An object that is particularly well insulated from the ground, such as a car on rubber tires, can actually store an electrical charge, becoming what is called "capacitively charged." A person standing on the ground and touching the car receives an electrical shock due to the sudden discharge of the capacitive charge through the person's body to the ground. The intensity of the shock depends on several factors, including:

- the strength of the electrostatic field which, in turn, depends on the voltage of the transmission line
- the height of the line above the ground
- the size of the object on the ground.

In 1977, the NESC® adopted a provision that describes how to establish minimum vertical clearances to the ground for electric lines having voltages exceeding 98 kilovolt (kV) alternating current to ground[1]. The clearance must limit the induced current[2] due to electrostatic effects to 5 milliamperes if the largest anticipated truck, vehicle, or equipment were short-circuited to ground. The NESC® chose this limit as being protective of the health of a person who wears a heart pacemaker. By way of comparison, the setting of ground fault circuit interrupters used in residential wiring (special breakers for outside circuits or those with outlets around water pipes) is 6 milliamperes; the shock that one feels on a dry day after walking on a carpet or sliding across a car seat and touching an object is the result of approximately 3 milliamperes of current.

As described in Section 3.1.3, there is one 230-kV line and three 500-kV lines that distribute power from NAPS to the Dominion grid. Line 255 to South Anna was designed in accordance with the NESC® 5 milliampere provision. The other lines were designed before NESC prescribed the 5 milliampere limit.

Dominion's analysis of the transmission lines first identified the limiting case for each of the four transmission lines. The limiting case is the configuration along each transmission line where the potential for current-induced shock would be greatest. Because the NAPS transmission line corridors do not contain multiple NAPS lines, the limiting case for each line was determined primarily by ground clearance and tower configuration. Once the limiting case was identified, Dominion calculated the electrostatic field strength for each transmission line, then calculated the induced current, as described below.

Dominion calculated field strength and induced current using a computer code called ENG01814. This code was developed by Cincinnati Gas & Electric Company and has been used at Dominion since 1978. The results of this computer program have been field-verified through actual electric field measurements under energized transmission lines. The input parameters for this code included the design features of the limiting-case scenario for each transmission line, the NESC® requirement that line sag be determined at 120°F conductor temperature, and the maximum vehicle size under the lines as a tractor-trailer 55 feet long,

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1. Part 2, Rules 232C1c and 232D3c.
2. The NESC® and the GEIS use the phrase "steady-state current," whereas 10 CFR 51.53(c)(3)(ii)(H) uses the phrase "induced current." The phrases mean the same here.

8.2 feet wide, and an average of 11.8 feet high. Dominion calculated the 120°F clearance based on design clearances.

The analysis determined that none of the four transmission lines has the capacity to induce as much as 5 milliamperes in a vehicle parked beneath the lines. Therefore, all the NAPS transmission line designs conform to the NESC® provisions for preventing electric shock from induced current. The results for each transmission line are provided in Table 4-4.

[picture not included] Dominion transmission lines

Dominion's assessment under 10 CFR 51 concludes that electric shock is of small significance for the NAPS transmission lines. This conclusion would remain valid into the future, provided there are no changes in line use, voltage, current, and maintenance practices and no changes in land use under the lines – conditions over which Dominion has control. Dominion surveillance and maintenance procedures (see Section 3.1.3) provide assurance that design ground clearances will not change. Due to the small significance of the issue, mitigation measures such as installing warning signs at road crossings or, in the extreme, increasing clearances, are not warranted.

4.14 Housing Impacts

NRC Input

The environmental report must contain "...[a]n assessment of the impact of the proposed action on housing availability..." 10 CFR 51.53(c)(3)(ii)(l)

"Housing impacts are expected to be of small significance at plants located in a medium or high population area and not in an area where growth control measures that limit housing development are in effect. Moderate or large housing impacts of the workforce associated with refurbishment may be associated with plants located in sparsely populated areas or areas with growth control measures that limit housing development." 10 CFR 51, Subpart A, Appendix B, Table B-1, Issue 63

"...[S]mall impacts result when no discernible change in housing availability occurs, changes in rental rates and housing values are similar to those occurring statewide, and no housing construction or conversion occurs." Ref. 4.0-1, Section 4.7.1.1

NRC made housing impacts a Category 2 issue, because impact magnitude depends on local conditions that the NRC could not predict for all plants at the time of GEIS publication (Ref. 4.0-1, Section 3.7.2). Local conditions to be ascertained are: (1) population categorization as low, medium, or high, and (2) applicability of growth control measures.

Housing impacts could result from increased staffing for refurbishment activities and/or continued operations. As described in Section 3.2, Dominion does not plan to perform major refurbishment. Dominion concludes that there would be no refurbishment-related impacts to area housing and no analysis is therefore required. Accordingly, the following discussion focuses on impacts of continued operations on local housing availability.

As described in Section 2.6, NAPS is located in a medium population area. As noted in Section 2.9, the assumed area of potential impact (Henrico, Louisa, Orange, and Spotsylvania Counties) is not subject to growth control measures that limit housing development. In 10 CFR 51, Subpart A, Appendix B, Table B-1, NRC concluded that impacts to housing are expected to be of small significance at plants located in "medium" population areas where growth control measures are not in effect. Therefore, Dominion expects housing impacts to be small.

This conclusion is supported by the following site-specific housing analysis. The maximum impact to area housing is calculated using the following assumptions: (1) all direct and indirect jobs would be filled by in-migrating residents; (2) the residential distribution of new residents would be similar to current worker distribution; and (3) each new job created (direct and indirect) represents one housing unit. As described in Section 3.4, approximately 73 percent of the NAPS employees reside in Henrico, Louisa, Orange, and Spotsylvania Counties. Therefore, the focus of the housing impact analysis is on these areas. As also

discussed in Section 3.4, Dominion's conservative estimate of 60 license renewal employees could generate the demand for 283 housing units (for 60 direct and 223 indirect workers). If it is assumed that 73 percent of the 283 new workers would locate in the four areas, consistent with current employee trends, a housing demand of 207 new units would be required in Henrico, Louisa, Orange, and Spotsylvania Counties. With an estimated combined housing stock in 1990 of approximately 140,570 units (Ref. 4.14-1, Ref. 4.14-2, Ref. 4.14-3 and Ref. 4.14-4), the 207 new housing units required by the new workers represent only 0.1 percent of the total existing housing stock. With these counties already experiencing steady growth, this demand would not create a discernible change in housing availability, rental rates or housing values, or spur housing construction or conversion. Because impacts would be small, mitigative measures would not be warranted.

4.15 Public Utilities: Public Water Supply Availability

NRC Input

The environmental report must contain "...an assessment of the impact of population increases attributable to the proposed project on the public water supply." 10 CFR 51.53(c)(3)(ii)(l)

"An increased problem with water shortages at some sites may lead to impacts of moderate significance on public water supply availability." 10 CFR 51, Subpart A, Appendix B, Table B-1, Issue 65

"Impacts on public utility services are considered small if little or no change occurs in the ability to respond to the level of demand and thus there is no need to add capital facilities. Impacts are considered moderate if overtaxing of facilities during peak demand periods occurs. Impacts are considered large if existing service levels (such as quality of water and sewage treatment) are substantially degraded and additional capacity is needed to meet ongoing demands for services." Ref. 4.0-1, Section 3.7.4.5

NRC made public utility impacts a Category 2 issue because an increased problem with water availability could occur in conjunction with plant demand and plant-related population growth, resulting from pre-existing water shortages in some areas (Ref. 4.0-1, Section 4.7.3.5). Local information needed would include: (1) a description of water shortages experienced in the area, and (2) an assessment of the public water supply system's available capacity.

The NRC's analysis of impacts to the public water supply system considered both plant demand and plant-related population growth demands on local water resources. Section 3.4 describes potential population increases, and Section 2.6 describes the distribution of that population in the area associated with license renewal activities at NAPS. Section 2.10 describes the public water supply systems potentially affected by license renewal activities, their permitted capacities, and current demands. NAPS does not use water from a municipal system; therefore, Dominion does not expect NAPS to have a direct effect on local water supplies. As discussed in Section 3.2, no major refurbishment is planned for NAPS and no refurbishment impacts are therefore expected.

The impact to the local water supply systems resulting from plant-related population growth can be determined by calculating the amount of water that would be required by these individuals. The average American uses between 50 and 80 gallons per day for personal use (Ref. 4.15-1, pg. 2). As described in Section 3.4, Dominion's conservative estimate of 60 license renewal employees could generate a total of 283 new jobs, which could result in a population increase of 722 in the area (283 jobs multiplied by 2.55, which is the average number of persons per household in the Commonwealth of Virginia) (Ref. 4.15-2). Using this

consumption rate, the plant-related population increase would require an additional 57,760 gallons per day (722 people multiplied by 80 gallons per day). If it is assumed that this increase is distributed across the four potentially affected counties considered in this analysis, consistent with current employee trends, the increase in water demand would represent an insignificant percentage of capacity for the water supply systems in these communities. Two of the counties have the majority of their populations using onsite groundwater wells as their drinking water source, and there are no limitations on numbers of future wells to be permitted. Existing municipal systems have adequate reserve capacity or have plans in place to address the need for expansion. See Section 2.10 for a discussion of the current capacities of these systems. Dominion concludes that impacts resulting from plant-related population growth to public water supplies would be small, requiring no additional capacity and not warranting mitigation.

4.16 Education Impacts from Refurbishment

NRC Input

The environmental report must contain "...an assessment of the impact of the proposed action on... public schools (impacts from refurbishment activities only) within the vicinity of the plant...." 10 CFR 51.53(c)(3)(ii)(I)

"...Most sites would experience impacts of small significance but larger impacts are possible depending on site- and project-specific factors...." 10 CFR 51, Subpart A, Appendix B, Table B-1, Issue 66

"...[S]mall impacts are associated with project-related enrollment increases of 3 percent or less. Impacts are considered small if there is no change in the school systems' abilities to provide educational services and if no additional teaching staff or classroom space is needed. Moderate impacts generally are associated with 4 to 8 percent increases in enrollment. Impacts are considered moderate if a school system must increase its teaching staff or classroom space even slightly to preserve its pre-project level of service.... Large impacts are associated with enrollment increases greater than 8 percent...." Ref. 4.0-1, Section 3.7.4.1

NRC made impacts to education a Category 2 issue because site- and project-specific factors determine the significance of impacts (Ref. 4.0-1, Section 3.7.4.2). Local factors to be ascer tained include: (1) project-related enrollment increases, and (2) status of the student/teacher ratio.

This issue is not applicable to NAPS because, as Section 3.2 discusses, Dominion has no plans for refurbishment at NAPS.

4.17 Offsite Land Use

4.17.1 Refurbishment

NRC Input

The environmental report must contain "...an assessment of the impact of the proposed action on... land-use... (impacts from refurbishment activities only) within the vicinity of the plant...." 10 CFR 51.53(c)(3)(ii)(I)

"...Impacts may be of moderate significance at plants in low population areas...." 10 CFR 51, Subpart A, Appendix B, Table B-1, Issue 68

"...[I]f plant-related population growth is less than 5 percent of the study area's total population, off-site land-use changes would be small, especially if the study area has established patterns of residential and commercial development, a population density of at least 60 persons per square mile, and at least one urban area with a population of 100,000 or more within 50 miles...." Ref. 4.0-1, Section 3.7.5

NRC made impacts to offsite land use as a result of refurbishment activities a Category 2 issue, because land-use changes could be considered beneficial by some community members and adverse by others. Local conditions to be ascer tained include:
(1) plant-related population growth, (2) patterns of residential and commercial development, and (3) proximity to an urban area with a population of at least 100,000.

This issue is not applicable to NAPS because, as Section 3.2 discusses, Dominion has no plans for refurbishment at NAPS.

4.17.2 License Renewal Term

NRC Input

The environmental report must contain "...[a]n assessment of the impact of the proposed action on ...land-use...within the vicinity of the plant..." 10 CFR 51.53(c)(3)(ii)(l)

"Significant changes in land use may be associated with population and tax revenue changes resulting from license renewal." 10 CFR 51, Subpart A, Appendix B, Table B-1, Issue 69

"...[I]f plant-related population growth is less than five percent of the study area's total population off-site land-use changes would be small..." Ref. 4.0-1, Section 3.7.5

"If the plant's tax payments are projected to be small relative to the community's total revenue, new tax-driven land-use changes during the plant's license renewal term would be small, especially where the community has preestablished patterns of development and has provided adequate public services to support and guide development." Ref. 4.0-1, Section 4.7.4.1

NRC made impacts to offsite land use during the license renewal term a Category 2 issue, because land-use changes may be perceived as beneficial by some community members and adverse by others. Therefore, NRC could not assess the potential significance of site-specific offsite land-use impacts (Ref. 4.0-1, Section 4.7.4.1). Site-specific factors to consider in an assessment of new tax-driven land-use impacts include: (1) the size of plant-related population growth compared to the area's total population, (2) the size of the plant's tax payments relative to the community's total revenue, (3) the nature of the community's existing land-use pattern, and (4) the extent to which the community already has public services in place to support and guide development.

The GEIS presents an analysis of offsite land use for the renewal term that is characterized by two components: population-driven and tax-driven impacts (Ref. 4.0-1, Section 4.7.4.1). Based on the GEIS case-study analysis, NRC concludes that all new population-driven land-use changes during the license renewal term at all nuclear plants would be small. Population growth caused by license renewal would represent a much smaller "percentage of the local areas" total population than the percentage presented by operations-related population growth (Ref. 4.0-1, Section 4.7.4.2).

Tax-Revenue-Related Impacts

NRC has determined that the significance of tax payments as a source of local government revenue would be large if the payments are greater than 20 percent of revenue (Ref. 4.0-1, Section 4.7.2.1). NRC defined the magnitude of land-use changes as follows (Ref. 4.0-1, Section 4.7.4):

- Small - very little new development and minimal changes to an area's land-use pattern
- Moderate - considerable new development and some changes to land-use pattern
- Large - large-scale new development and major changes in land-use pattern.

NRC further determined that, if a plant's tax payments are projected to be a dominant source of a community's total revenue (i.e., greater than 20 percent of revenue), new tax-driven land-use changes would be large.

Table 2-3 provides a comparison of total tax payments made by Dominion to Louisa, Orange, and Spotsylvania Counties and the Counties' operating budgets. For the 4-year period from 1995 through 1998, Dominion's tax payments to Louisa County represented approximately 50 percent of Louisa County's yearly property tax revenues and 25 percent of its annual budget. Dominion's tax payment to Orange and Spotsylvania Counties represented approximately 0.4 and 0.3 percent of the respective Counties' annual operating budgets. Using NRC's criteria, Dominion's tax payments could be of large significance to Louisa County. For the reasons presented below, however, Dominion does not anticipate large land-use changes as a result of these tax revenues.

As described in Section 3.2, Dominion does not anticipate major refurbishment or construction during the license renewal period. Therefore, Dominion does not anticipate any increase in the assessed value of NAPS due to refurbishment-related improvements nor any related tax-increase-driven changes to offsite land use and development patterns. NAPS has been, and would probably continue to be, the dominant source of tax revenue for Louisa County. Since plant construction in 1972, Louisa and Spotsylvania Counties have experienced land-use changes. The land adjacent to Lake Anna and the WHTF has seen significant development for primary and vacation homes. On the Spotsylvania side of Lake Anna, marinas have sprung up to serve the needs of both residents and seasonal visitors. County population growth rates after NAPS construction were significant in the 1970s. Growth slowed down in the 1980s and increased again in the 1990s; County planners anticipate this growth to continue (Ref. 4.17-1). Growth in the industrial service sectors has been slower to come to Louisa County. The majority of Louisa County's workforce commutes out of the County for employment (Ref. 2.7-5). Dominion believes continued operation of NAPS would be important to maintaining the current level of development and

public services, and does not anticipate plant-induced changes to local land-use and development patterns as a result of license renewal.

Conclusion

Recent Louisa County land-use changes have been consistent with changes in the region in general. Section 2.6 describes the regional population growth trend away from existing metropolitan areas and toward less developed areas, such as Louisa County. The County's proximity to the Richmond and Charlottesville metropolitan areas, one-hour and half-hour drives, respectively, and the attraction of Lake Anna for transient recreational use and for home sites are factors that have contributed to the growth of residential development. Though tax payments to Louisa County are of large significance to the County, the magnitude of tax-driven land use changes have been small. Dominion therefore concludes that mitigative measures would be unwarranted.

4.18 Transportation

NRC Input

"All applicants shall assess the impact of highway traffic generated by the proposed project on the level of service of local highways during periods of license renewal refurbishment activities and during the term of the renewed license." 10 CFR 51.53(c)(3)(ii)(J)

"Transportation impacts are generally expected to be of small significance. However, the increase in traffic associated with the additional workers and local road and traffic control conditions may lead to impacts of moderate or large significance at some sites." 10 CFR 51, Subpart A, Appendix B, Table B-1, Issue 70

"Small impacts would be associated with a free flowing traffic stream where users are unaffected by the presence of other users (level of service A) or stable flow in which the freedom to select speed is unaffected but the freedom to maneuver is slightly diminished (level of service B)." Ref. 4.0-1, Section 3.7.4

NRC made impacts to transportation a Category 2 issue, because impact significance is determined primarily by road conditions existing at the time of the project, which NRC could not forecast for all plants (Ref. 4.0-1, Section 3.7.4.2). Local road conditions to be ascertained are: (1) level of service conditions, and (2) incremental increase in traffic associated with refurbishment activities and license renewal staff.

As described in Section 3.2, no major refurbishment is planned and no refurbishment impacts to local transportation are therefore anticipated. As noted in Section 2.10.2, access to NAPS is via State Routes 700 and 652, which carry a level of service (LOS) designation of "B". GEIS Section 3.7.4.2 (Ref. 4.0-1) concluded that impacts to roads with an LOS designation of "B" are small, because the operation of individual users is not substantially affected by the presence of other users. At this level, no delays occur and no improvements are needed.

Dominion's NAPS workforce includes 851 permanent and 70 to 100 contract and matrixed employees. One to two times a year, as many as 700 additional workers join the permanent workforce to participate in periodic refueling. Dominion's conservative projection of 60 additional employees associated with license renewal for NAPS represents a 6 percent increase in the current number of employees and an even smaller percentage of employees present onsite during periodic refueling. Given these employment projections and the LOS designation of "B" for the access roads to NAPS, it is consistent with the GEIS to conclude that impacts to transportation would be small and mitigative measures would be unwarranted.

4.19 Historic and Archaeological Resources

NRC Input

The environmental report must contain an assessment of "...whether any historic or archaeological properties will be affected by the proposed project." 10 CFR 51.53(c)(3)(ii)(K)

"Generally, plant refurbishment and continued operation are expected to have no more than small adverse impacts on historic and archaeological resources. However, the National Historic Preservation Act requires the Federal agency to consult with the State Historic Preservation Officer to determine whether there are properties present that require protection." 10 CFR 51, Subpart A, Appendix B, Table B-1, Issue 71

"Sites are considered to have small impacts to historic and archaeological resources if (1) the State Historic Preservation Officer (SHPO) identifies no significant resources on or near the site; or (2) the SHPO identifies (or has previously identified) significant historic resources but determines they would not be affected by plant refurbishment, transmission lines, and license-renewal term operations and there are no complaints from the affected public about the character; and (3) if the conditions associated with moderate impacts do not occur." Ref. 4.0-1, Section 3.7.7

NRC made impacts to historic and archaeological resources a Category 2 issue, because determinations of impacts to historic and archaeological resources are site-specific in nature, and the National Historic Preservation Act mandates that impacts must be determined through consultation with the State Historic Preservation Officer (SHPO) (Ref. 4.0-1, Section 4.7.7.3).

Dominion does not plan any land-disturbing refurbishment activit ies, and no refurbishment-related impacts are therefore anticipated. As described in Section 2.13, no known archaeological or historic sites of significance were threatened during NAPS's construction in the 1970s. Transmission line rights-of-way have been categorized and inventoried. No known archaeological or historic sites of significance have been identified; therefore, continued use of transmission lines and rights-of-way is projected to cause little or no impact. On April 12, 2000, Dominion initiated correspondence with the SHPO and is awaiting a response. See Section 9.1.4 and Appendix D for correspondence.

4.20 Severe Accident Mitigation Alternatives (SAMAs)

NRC Input

The environmental report must contain a consideration of alternatives to mitigate severe accidents "... if the staff has not previously considered severe accident mitigation alternatives for the applicant's plant in an environmental impact statement or related supplement or in an environment assessment..." 10 CFR 51.53(c)(3)(ii)(L)

"... The probability weighted consequences of atmospheric releases, fallout onto open bodies of water, releases to ground water, and societal and economic impacts from severe accidents are small for all plants. However, alternatives to mitigate severe accidents must be considered for all plants that have not considered such alternatives..." 10 CFR 51, Subpart A, Appendix B, Table B-1, Issue 76

The term "accident" in the current context refers to any unintentional event (i.e., outside the normal or expected plant operational parameters) that results in the release or the potential for release of radioactive material to the environment. Generally, NRC categorizes accidents as "design-basis" or "severe." Design-basis accidents are those for which the risk is great enough that an applicant is required to design and construct a plant to prevent unacceptable accident consequences. Severe accidents are those considered too unlikely to warrant design controls.

Historically, NRC has not included in its environmental impact statements or environmental assessments any analysis of alternative ways to mitigate the environmental impact of severe accidents. A 1989 court decision ruled that, in the absence of an NRC finding that severe accidents are remote and speculative, severe accident mitigation alternatives (SAMAs) should be considered in the NEPA analysis (*Limerick Ecology Action v. NRC*, 869 F.d 719 [3rd Cir. 1989]). For most plants, including NAPS, license renewal is the first licensing action that would necessitate consideration of SAMAs.

The NRC concluded in its generic license renewal rulemaking that the unmitigated environmental impacts from severe accidents meet the Category 1 criteria. However, NRC made consideration of mitigation alternatives a Category 2 issue because ongoing regulatory programs related to mitigation (i.e., Individual Plant Examination [IPE] and Accident Management) were not complete for all plants. Because these programs have identified plant programmatic and procedural improvements (and, in a few cases, minor modifications) as cost-effective in reducing severe accident risk and consequences, NRC thought it premature to draw a generic conclusion as to whether severe accident mitigation would be required for license renewal. Site-specific information to be presented in the environmental report includes: (1) potential SAMAs; (2) benefits and costs of implementing potential SAMAs; and (3) sensitivity of analysis to changes in key underlying assumptions.

The overall approach taken in this SAMA analysis includes the following steps:

- Establish the base case - Use NUREG/BR-0184 (Ref. 4.20-1, Chapter 5) to evaluate severe accident impacts. Include: offsite exposure cost; offsite economic cost; onsite exposure cost; onsite economic cost, including both cleanup and decommissioning; and replacement power.
- Identify potential SAMAs from sources such as NRC, industry documentation that discusses potential plant improvements, plant-specific sources such as the NAPS IPE, and Individual Plant Examination – External Events (IPEEE), as well as insight provided by NAPS's probabilistic risk assessment (PRA) staff.
- Qualitatively screen potential SAMAs. Eliminate obviously non-viable candidates, based on objective screening criteria.
- Perform benefit/cost evaluations for remaining SAMAs. Calculate the net value of implementing each remaining SAMA by subtracting the cost of implementing each SAMA from the benefit of each SAMA (averted offsite exposure and economic costs, as well as onsite exposure and economic costs).
- Identify any SAMAs having positive net values.

The NAPS SAMA analysis is presented in the following sections and in Appendix G, providing a detailed discussion of the process presented above.

4.20.1 **Establishing the Base Case**

The purpose of establishing the base case is to provide the baseline for determining risk reductions that would be attributable to the implementation of potential SAMAs. This severe accident risk, based on the NAPS PRA model, is evaluated in terms of dollars by using PRA analysis techniques. This analysis includes three levels. The first two levels are defined as follows: level 1 determines core damage frequencies based on system analyses and human-factor evaluations; and level 2 determines the physical and chemical phenomena that affect the performance of the containment and other radiological release mitigation features to quantify accident behavior and release of fission products to the environment. The primary source of data relating to the levels 1 and 2 analyses is the NAPS PRA model. Using the results of these analyses, the next step is to perform a level 3 PRA analysis, which calculates the hypothetical impacts of severe accidents on the surrounding environment and members of the public. The level 3 analysis was performed using the Melcor Accident Consequence Code System (MACCS2). MACCS2 simulates the impact of severe accidents at nuclear power plants on the surrounding environment. The MACCS2 computer code is used for determining the offsite impacts for the level 3 analysis, whereas the magnitude of

the onsite impacts (in terms of clean-up and decontamination costs and occupational dose) are based on information provided in NUREG/BR-0184 (Ref. 4.20-1).

The principal phenomena analyzed are: atmospheric transport of radionuclides; mitigative actions (i.e., evacuation, condemnation of contaminated crops and milk) based on dose projection; dose accumulation by a number of pathways, including food and water ingestion; and economic costs. Input for the level 3 analysis includes the NAPS core radionuclide inventory, source terms from the PRA model, site meteorological data, projected population distribution (within a 50-mile radius) for the year 2030, emergency response evacuation modeling, and economic data. Appendix G describes the MACCS2 input data and assumptions.

4.20.1.1 **Offsite Exposure Costs**

The level 3 base case analysis shows an annual avoided offsite exposure risk of 25.3990 person-rem (Ref. 4.20-2). This calculated value is converted to a monetary equivalent (dollars) via application of the NRC's conversion factor of $2,000 per person-rem (Ref. 4.20-3 and Appendix G). This dollar amount is then discounted to present value using NRC methodology (Ref. 4.20-1):

$$APE = (F_s D_{p_S} - F_A D_{p_A}) R \frac{1 - e^{-rt_f}}{r} \qquad (1)$$

where:

- APE = monetary value of avoided accident risk due to population doses (after discounting)
- R = monetary equivalent of unit dose ($2,000/person-rem)
- F = accident frequency (events/yr)
- D_P = population dose factor (person-rem/event)
- S = subscript denoting status quo (current conditions)
- A = subscript denoting status after implementation of proposed action
- r = real discount rate = 7 percent (as a fraction, 0.07)
- t_f = years remaining until end of facility life (20 years)

Using a 20-year period for remaining plant life and a 7 percent discount rate results in the monetary equivalent value of offsite exposure costs of $546,735 (Table 4-5).

4.20.1.2 **Offsite Economic Costs**

The level 3 analysis shows an annual offsite economic risk of $48,846 (Ref. 4.20-2 and Table 4-5). Calculated values of offsite economic costs caused by severe accidents are also discounted to present value. Discounting is performed in the same manner as for the public health risks in accordance with NRC methodology.

$$AOC = (F_s P_{D_s} - F_A P_{D_A}) \frac{1 - e^{-rt_f}}{r} \qquad (2)$$

where:

AOC = monetary value of avoided accident risk due to offsite property damage (after discounting)

P_D = offsite property loss factor (dollars/event)

The resulting monetary equivalent of offsite economic costs is $525,721, as presented in Table 4-5.

4.20.1.3 **Onsite Exposure Costs**

Values for occupational exposure from severe accidents are not derived from the PRA model, but are instead obtained from information published by the NRC (Ref. 4.20-1, Section 5.7.3). The values for occupational exposure consist of "immediate dose" and "long-term dose." The best-estimate value provided by the NRC for immediate occupational dose is 3,300 person-rem and for long-term occupational dose is 20,000 person-rem (over a 10-year clean-up period). The following equations are applied to these values to calculate monetary equivalents:

Immediate Dose

For a currently operating facility, NUREG/BR-0184 (Ref. 4.20-1, Section 5.7.3) recommends using the following methodology to calculate the immediate dose present value:

$$W_{io} = (F_s D_{io_s} - F_A D_{io_A}) R \frac{1 - e^{-rt_f}}{r} \qquad (3)$$

where:

W_{io} = monetary value of avoided accident risk due to immediate doses (after discounting)

IO = subscript denoting immediate occupational dose

R = monetary equivalent of unit dose, ($/person-rem)

F = accident frequency (events/yr)

D_{io} = immediate occupational dose (person-rem/event)

S = subscript denoting status quo (current conditions)

A = subscript denoting status after implementation of proposed action

r = real discount rate

t_f = years remaining until end of facility life

The values used in the analysis are:

R = $2000/person rem

r = 0.07

D_{io} = 3,300 person-rem/accident (best estimate)

t_f = 20 years

Assuming F_A (accident frequency) is zero for the base case, the monetary value of the immediate dose associated with the plant accident risk is:

$$W_{io} = (F_s D_{io_S}) R \frac{1 - e^{-rt_f}}{r}$$

$$= 3300 * F * \$2,000 * \frac{1 - e^{-0.07*20}}{0.07}$$

The core damage frequency for the base case is 3.50×10^{-5}/year; therefore,

$W_{io} = \$2,487$. The monetary equivalent of short-term exposure costs is $2,487.

Long-Term Dose

For a currently operating facility, NUREG/BR-0184 (Ref. 4.20-1, Section 5.7.3) recommends calculating the long-term dose present value using the following equation:

$$W_{LTO} = (F_s D_{LTO_s} - F_A D_{LTO_A}) R * \frac{1 - e^{-rt_f}}{r} * \frac{1 - e^{-m}}{rm} \qquad (4)$$

where:

W_{LTO} = monetary value of accident-risk-avoided long term doses (after discounting)

LTO = subscript denoting long-term occupational doses

m = years over which long-term doses accrue

The values used in the analysis are:

R = $2000/person rem

r = 0.07

D_{LTO} = 20,000 person-rem/accident (best estimate)

m = "as long as 10 years"

t_f = 20 years

For the basis discount rate, assuming F_A is zero, the monetary value of the long-term dose associated with the plant accident risk is:

$$W_{LTO} = (F_s D_{LTO_s}) R * \frac{1 - e^{-rt_f}}{r} * \frac{1 - e^{-rm}}{rm}$$

$$= (F_S \times 20,000) * \$2,000 * \frac{1 - e^{-0.07*20}}{0.07} * \frac{1 - e^{-0.07*10}}{0.07*10}$$

The core damage frequency for the base case is 3.50×10^{-5}/year; therefore, $W_{LTO} = \$10,839$. The monetary equivalent of long-term exposure costs is $10,839.

Total Occupational Exposures

As shown in Table 4-5, combining the immediate and long-term dose equations and using the numeric values given above, the long-term accident-related-onsite (occupational) exposure avoided (AOE) is:

$$AOE = W_{io} + W_{LTO} \ (\$)$$

The best estimate value for occupational exposure (AOE_B) is:

$$AOE_B = W_{io} + W_{LTO} = \$2{,}487 + \$10{,}839 = \$13{,}326$$

4.20.1.4 **Onsite Economic Costs Clean-up/Decontamination**

The total cost of clean-up and decontamination of a power reactor facility following a severe accident is estimated in NUREG/BR-0184 to be $\$1.5 \times 10^9$; this value is also adopted for these analyses. Considering a 10-year clean-up period, the present value of this cost is:

$$PV_{CD} = \left(\frac{C_{CD}}{m}\right)\left(\frac{1 - e^{-rm}}{r}\right)$$

where:

PV_{CD} = present value of the cost of clean-up/decontamination

C_{CD} = total cost of the clean-up/decontamination effort, $\$1.5 \times 10^9$

m = clean-up period

r = discount rate

Therefore, based on the values previously assumed:

$$PV_{CD} = \left(\frac{\$1.5E+9}{10}\right)\left(\frac{1 - e^{-0.07*10}}{0.07}\right)$$

$$PV_{CD} = \$1.079E+9$$

This cost is integrated over the term of the proposed license extension as follows:

$$U_{CD} = PV_{CD}\frac{1 - e^{-rt_f}}{r}$$

where:

U_{CD} = net present value of clean-up/decontamination over the life of the plant

Based on the values previously assumed:

$U_{CD} = \$1.079E + 9\ [10.763]$

$U_{CD} = \$1.161E+10$

Replacement Power Costs

Replacement power costs, URP, are an additional contributor to onsite costs. These are calculated in accordance with NUREG/BR-0184 (Ref. 4.20-1, Section 5.6.7.2.) Since replacement power will be needed for that time period following a severe accident for the remainder of the expected generating plant life, long-term power replacement calculations have been used. For a "generic" plant of 910 MWe, the present value of replacement power is calculated as follows:

$$PV_{RP} = \left(\frac{1.2E + 8}{r}\right)(1 - e^{-rt_f})^2$$

where:

PV_{RP} = present value of the cost of replacement power for a single event

t_f = years remaining until end of facility life

r = discount rate

The $1.2 × 10^8 value has no intrinsic meaning, but is a substitute for a string of non-constant replacement power costs that occur over the lifetime of a "generic" reactor after an event (Ref. 4.20-1, Section 5.7.6). This equation was developed per NUREG/BR-0184 for discount rates between 5 and 10 percent only.

For discount rates between 1 and 5 percent, Ref. 4.20-1 indicates that a linear interpolation is appropriate between present values of $1.2 × 10^9 at 5 percent and $1.6 × 10^9 at 1 percent. For discount rates in this range, the following equation was used to perform the linear interpolation.

$$PV_{RP} = (\$1.6E+9) - \left(\frac{[(\$1.6E+9)] - [(\$1.2E+9)]}{[5\% - 1\%]} * [r_s - 1\%] \right)$$

where:

r_s = discount rate (small), between 1 percent and 5 percent

To account for the entire lifetime of the facility, U_{RP} was then calculated from PV_{RP} as follows:

$$U_{rp} = \frac{PV_{RP}}{r}(1 - e^{-rt_f})^2$$

where:

U_{RP} = present value of the cost of replacement power over the life of the facility

Again, this equation is only applicable in the range of discount rates from 5 to 10 percent. NUREG/BR-0184 states that, for lower discount rates, linear interpolations for U_{RP} are recommended between $\$1.9 \times 10^{10}$ at 1 percent and $\$1.2 \times 10^{10}$ at 5 percent. The following equation was used to perform this linear interpolation:

$$U_{RP} = (\$1.9E+10) - \left(\frac{[(\$1.9E+10)] - [(\$1.2E+10)]}{[5\% - 1\%]} * [r_s - 1\%] \right)$$

where:

r_s = discount rate (small), between 1 and 5 percent

The NAPS units have a gross electrical rating of 982 MWe and a net of 893/897 MWe. The gross rating of 982 MWe will conservatively be used in this calculation, yielding a scaling factor of 1.08 (982/910) to be applied to these formulae.

Repair and Refurbishment

Dominion has no plans for major repair/refurbishment following a severe accident; therefore, there is no contribution to averted onsite costs from this source.

Total Onsite Economic Costs

The total averted onsite economic cost is, therefore:

$$AOSC = F^{*} (U_{CD} + U_{RP})$$

where:

F = annual frequency of the event

AOSC = averted onsite economic cost

AOSC = $682,695. The monetary equivalent of total averted onsite costs is $682,695.

4.20.2 **SAMA Identification and Screening**

The list of potential enhancements was developed by reviewing industry documents from which reasonable ideas could be gleaned. In addition to the industry sources, plant-specific sources were also reviewed. The NAPS IPE and IPEEE were examined to determine if there were any additional plant-specific improvements that had not been evaluated in those documents. The NAPS PRA staff also provided several plant-specific items that were included in the evaluation. Finally, the top 100 cutsets of the updated level 1 PRA were examined to identify the important contributors to plant risk (both plant equipment and operator actions). Shutdown-related improvements are not addressed explicitly. However, SAMAs that affect structures, systems, and components that may enhance mitigative functions during both at-power and shutdown conditions are addressed.

The comprehensive set of sources considered in developing the SAMA list is as follows:

- The NAPS IPE submittal (only items not already evaluated and/or implemented during the IPE) (Ref. G.2-1 in Appendix G)
- The Watts Bar Nuclear Plant Unit 1 PRA/IPE submittal (Ref. G.2-2 in Appendix G)
- The Limerick Severe Accident Mitigation Design Alternatives (SAMDA) cost estimate report (Ref. G.2-3 in Appendix G)
- NUREG-1437 description of Limerick SAMDA (Ref. G.2-4 in Appendix G)

- NUREG-1437 description of Comanche Peak SAMDA (Ref. G.2-5 in Appendix G)
- Watts Bar SAMDA submittal (Ref. G.2-6 in Appendix G)
- TVA response to NRC's Request for Additional Information on the Watts Bar SAMDA submittal (Ref. G.2-7 in Appendix G)
- Westinghouse AP600 SAMDA (Ref. G.2-8 in Appendix G)
- Safety Assessment Consulting presentation by Wolfgang Werner at the NUREG-1560 conference (Ref. G.2-9 in Appendix G)
- NRC IPE Workshop - NUREG-1560 NRC Presentation (Ref. G.2-10 in Appendix G)
- NUREG 0498, Supplement 1, Section 7 (Ref. G.2-11 in Appendix G)
- NUREG/CR-5567, Pressurized Water Reactor (PWR) Dry Containment Issue Characterization (Ref. G.2-12 in Appendix G)
- NUREG-1560, Volume 2, NRC Perspectives on the IPE Program (Ref. G.2-13 in Appendix G)
- NUREG/CR-5630, PWR Dry Containment Parametric Studies (Ref. G.2-14 in Appendix G)
- NUREG/CR-5575, Quantitative Analysis of Potential Performance Improvements for the Dry PWR Containment (Ref. G.2-15 in Appendix G)
- CE System 80+ Submittal (Ref. G.2-16 in Appendix G)
- NUREG-1462, NRC Review of ABB/CE System 80+ Submittal (Ref. G.2-17 in Appendix G)
- An ICONE paper by C. W. Forsberg, et al., on a core melt source reduction system (Ref. G.2-18 in Appendix G)
- The NAPS IPEEE submittal (only those items not already evaluated and/or implemented during the IPEEE) (Ref. G.2-19 in Appendix G)
- Additional items from the NAPS PRA staff or from review of the top 100 cutsets

Although NAPS is a Westinghouse design, all above documents were reviewed for potential SAMAs, even if they were not necessarily applicable to a Westinghouse plant. Those items not applicable to NAPS were subsequently removed from the list. The containment performance improvement programs for boiling water reactors and ice condenser plants were not reviewed (and the NUREG-1560 portion of the containment performance improvement for these was not reviewed). Conceptual enhancement for which no specific details were available (e.g., "improve diesel reliability" or "improve procedures for loss of

support systems") were not included, unless they were considered as vulnerabilities in the NAPS IPE.

The SAMAs that have been identified for consideration are presented in Table G.2-1 in Appendix G. The list included a total of 158 items.

4.20.2.1 Qualitative Screening of SAMAs

The last two columns of Table G.2-1 in Appendix G present the qualitative screening of the initial list. Items were eliminated from further evaluation based on one of the following criteria:

- The SAMA was not applicable at NAPS, either because the enhancement was only for boiling water reactors, the Westinghouse AP600 design, or PWR ice condenser containments, or it was a plant-specific enhancement that did not apply at NAPS (Criterion A); or
- The SAMA had already been implemented at NAPS (or the NAPS design met the intent of the SAMA) (Criterion B), or
- The SAMA was related to a reactor coolant pump (RCP) seal vulnerability at many PWRs, stemming from charging pump dependency on Component Cooling Water (CCW). The NAPS does not have this vulnerability because the charging pumps do not rely on CCW. However, other RCP seal loss-of-coolant accident (LOCA) improvements were still considered (Criterion C).

Based on preliminary screening, 107 SAMAs were either eliminated or combined with other potential improvements, leaving 51 SAMAs subject to the benefit/cost process. These improvements are listed in Table 4-6. The benefit/cost portion of Table 4-6 is described in Section 4.20.2.2.

4.20.2.2 Benefit/Cost Analyses

The final screening process involved identifying and eliminating those items whose cost exceeded their benefit.

The SAMA benefit is evaluated in dollar terms by using PRA analysis techniques. This includes levels 1 and 2 results, using the NAPS PRA model, and a level 3 analysis, using the MACCS2 code (Ref. 4.20-4).

The level 3 results are determined based on the grouped level 2 containment release frequencies, and encompass both onsite and offsite consequences. The onsite consequences are proportional to core damage, while the offsite consequences differ for each containment release category. The consequences include a radiation dose term (in person-rem) and a property loss (cost) term in

dollars. As described in Section 4.20.1, the dose term is converted to dollars and added to the property losses for both onsite and offsite consequences. The reduction in the total potential cost of an accident by implementing a SAMA constitutes the benefit of that SAMA. This benefit is compared with the estimated cost of implementing the SAMA to determine the overall net value of implementing that SAMA.

The maximum theoretical benefit (also called Maximum Attainable Benefit, or MAB) is based upon the elimination of all plant risk and equates to the previously calculated base case risk. The costs associated with those SAMAs that involve major plant modifications may simply be compared with this benefit as a means of eliminating them from further consideration (e.g., a SAMA that would require construction of a large structure might be compared with the MAB).

Staff experienced in estimating the cost of performing work at a nuclear power plant prepared all the SAMA cost analyses. The depth of analysis performed varied depending on the magnitude of the expected benefit. Detailed cost estimating was performed only in those situations in which the expected benefit is significant. For all other SAMAs, order of magnitude estimates of the hardware modifications were sufficient. To account for uncertainty in the cost estimates,

Table 4-6 shows that all of the SAMAs screened with a cost that was at least twice the calculated benefit. Therefore, even if the cost estimates were to vary from the order of magnitude estimate, they would have to differ by at least a factor of two before becoming significant. The factor of two presented in Table 4-6 was chosen arbitrarily, but provided confidence that even when uncertainties are considered, the conclusions would not change. If a SAMA involved a hardware modification, it was assumed that the cost would be at least $100,000. For the generation of a new procedure and its implementation, it was assumed that the cost would be at least $30,000.

Benefit Calculations

For each SAMA evaluation, a revised set of plant damage state frequencies was generated. Using the revised plant damage state frequencies, a revised level 3 dollars-averted calculation was performed. The results are presented in Table 6 of (Ref. 4.20-2).

Each evaluation in Appendix G contains a description of the plant change that is represented by the case, a description of the changes that were made in the fault trees, event trees, and/or databases in the PRA to calculate the benefit. In addition, each case contains the summary results of the fault tree analysis for the

case, in the form of improvement in Core Damage Frequency (CDF) and in offsite release frequency. The results of these benefit calculations are presented in Table 4-6.

The PRA calculations of SAMA benefit are recognized to have some uncertainty around the mean frequencies used in the analyses. Some of the uncertainty is related to quantifiable uncertainty distributions of the data, while other stems from unquantifiable uncertainty in the PRA assumptions. To account for the possible uncertainty, rather than perform a quantitative uncertainty and analysis, several sensitivity analyses on key input information were performed to bound the analysis.

Cost Estimates

The cost estimates were generally made as an order of magnitude approximation. For most of the SAMAs considered, the conservative cost estimates were sufficiently greater than the benefits calculated, such that no additional evaluation was required. The cost estimates were generated by NAPS staff and are presented in Table 4-6.

The benefits resulting from the bounding estimates presented in the benefit analysis are, in general, rather small. In most cases, the benefits are so small that it is obvious that the implementation costs would exceed the benefits, even without a detailed cost estimate. In many cases, plant staff judgment is applied in assessing whether the benefit approaches the expected implementation costs.

Detailed cost estimating is only applied in those situations in which the benefit is significant and application of judgment would be questioned.

4.20.3 **Conclusions**

As shown in Table 4-6, none of the SAMA analyzed would be justified on a benefit/cost basis. In other words, none of the analyzed modifications would provide more benefits than they would cost.

Dominion performed a sensitivity analysis by substituting a 3 percent discount rate for the 7 percent discount rate used for the above analysis, as recommended in (Ref. 4.20-1). This reduced discount rate takes into account the additional uncertainties (i.e., interest rate fluctuations) in predicting costs for activities that would take place several years in the future. The results of this sensitivity analysis are presented in Appendix G, and the results hold for the range of discounts used in the sensitivity analysis

TABLES

Table 4-1
Category 1 Issues That Do Not Apply to
North Anna Power Station Units 1 & 2 (NAPS)[a]

	Issue	Basis for inapplicability to NAPS
	Surface Water Quality, Hydrology, and Use (for all plants)	
1.	Impacts of refurbishment on surface water quality	Impacts apply to an activity, refurbishment, that NAPS will not undertake.
2.	Impacts of refurbishment on surface water use	Impacts apply to an activity, refurbishment, that NAPS will not undertake.
4.	Altered salinity gradients	Issue applies to a saltwater receiving water body, that NAPS does not have.
	Aquatic Ecology (for all plants)	
14.	Refurbishment impacts to aquatic resources	Impacts apply to an activity, refurbishment, that NAPS will not undertake.
	Aquatic Ecology (for plants with cooling-tower-based heat dissipation systems)	
28.	Entrainment of fish and shellfish in early life stages for plants with cooling-tower-based heat dissipation systems	Issue applies to a heat dissipation system, cooling towers, that NAPS does not have.
29.	Impingement of fish and shellfish for plants with cooling-tower-based heat dissipation systems	Issue applies to a heat dissipation system, cooling towers, that NAPS does not have.
30.	Heat shock for plants with cooling-tower-based heat dissipation systems	Issue applies to a heat dissipation system, cooling towers, that NAPS does not have.
	Groundwater Use and Quality	
31.	Impacts of refurbishment on groundwater use and quality	Impacts apply to an activity, refurbishment, that NAPS will not undertake.
36.	Groundwater quality degradation (Ranney wells)	Issue applies to a heat dissipation system feature, Ranney wells, that NAPS does not have.
37.	Groundwater quality degradation (saltwater intrusion)	Issue applies to plants in coastal areas; NAPS is located inland.
38.	Groundwater quality degradation (cooling ponds in salt marshes)	Issue applies to a heat dissipation system using cooling ponds in coastal areas that NAPS does not have.

Table 4-1 (Cont'd)
Category 1 Issues That Do Not Apply to
North Anna Power Station Units 1 & 2 (NAPS)[a]

Issue	Basis for inapplicability to NAPS
Terrestrial Resources	
41. Cooling tower impacts on crops and ornamental vegetation	Issue applies to a heat dissipation system feature, cooling towers, that NAPS does not have.
42. Cooling tower impacts on native plants	Issue applies to a heat dissipation system feature, cooling towers, that NAPS does not have.
43. Bird collisions with cooling towers	Issue applies to a heat dissipation system feature, cooling towers, that NAPS does not have.
44. Cooling pond impacts on terrestrial resources	Issue applies to a heat dissipation system, cooling ponds, that NAPS does not have.
Human Health	
54. Radiation exposures to the public during refurbishment	Impacts apply to an activity, refurbishment, that NAPS will not undertake.
55. Occupational radiation exposures during refurbishment	Impacts apply to an activity, refurbishment, that NAPS will not undertake.
56. Microbiological organisms (occupational health)	Issue applies to workers in cooling towers that NAPS does not have.
Socioeconomics	
72. Aesthetic impacts (refurbishment)	Impacts apply to an activity, refurbishment, that NAPS will not undertake.

a. NRC listed the issues in Table B-1 of 10 CFR 51 Appendix B. Dominion added issue numbers for expediency.

Table 4-2
Category 1 and NA Issues That Apply to
North Anna Power Station Units 1 & 2 (NAPS)[a]

	Issue	NRC Findings[b]	GEIS Reference (Section/Page)
		Surface Water Quality, Hydrology, and Use (for all plants)	
3.	Altered current patterns at intake and discharge structures	SMALL. Altered current patterns have not been found to be a problem at operating nuclear power plants and are not expected to be a problem during the license renewal term.	4.2.1.2.1/4-4
5.	Altered thermal stratification of lakes	SMALL. Generally, lake stratification has not been found to be a problem at operating nuclear power plants and is not expected to be a problem during the license renewal term.	
6.	Temperature effects on sediment transport capacity	SMALL. These effects have not been found to be a problem at operating nuclear power plants and are not expected to be a problem during the license renewal term.	4.2.1.2.3/4-6
7.	Scouring caused by discharged cooling water	SMALL. Scouring has not been found to be a problem at most operating nuclear power plants and has caused only localized effects at a few plants. It is not expected to be a problem during the license renewal term.	4.4.2.2/4-6
8.	Eutrophication	SMALL. Eutrophication has not been found to be a problem at operating nuclear power plants and is not expected to be a problem during the license renewal term.	4.2.1.2.3/4-6
9.	Discharge of chlorine or other biocides	SMALL. Effects are not a concern among regulatory and resource agencies, and are not expected to be a problem during the license renewal term.	4.2.1.2.4/4-10
10.	Discharge of sanitary wastes and minor chemical spills	SMALL. Effects are readily controlled through National Pollutant Discharge Elimination System (NPDES) permit and periodic modifications, if needed, and are not expected to be a problem during the license renewal term.	4.2.1.2.4/4-10
11.	Discharge of other metals in waste water	SMALL. These discharges have not been found to be a problem at operating nuclear power plants with cooling-tower-based heat dissipation systems and have been satisfactorily mitigated at other plants. They are not expected to be a problem during the license renewal term.	4.2.1.2.4/4-10
12.	Water use conflicts (plants with once-through cooling systems)	SMALL. These conflicts have not been found to be a problem at operating nuclear power plants with once-through heat dissipation systems.	4.2.1.3/4-13

Table 4-2 (Cont'd)
Category 1 and NA Issues That Apply to
North Anna Power Station Units 1 & 2 (NAPS)[a]

Issue	NRC Findings[b]	GEIS Reference (Section/Page)
	Aquatic Ecology (for all plants)	
15. Accumulation of contaminants in sediments or biota	SMALL. Accumulation of contaminants has been a concern at a few nuclear power plants but has been satisfactorily mitigated by replacing copper alloy condenser tubes with those of another metal. It is not expected to be a problem during the license renewal term.	4.2.1.2.4/4-10
16. Entrainment of phytoplankton and zooplankton	SMALL. Entrainment of phytoplankton and zooplankton has not been found to be a problem at operating nuclear power plants and is not expected to be a problem during the license renewal term.	4.2.2.1.1/4-15
17. Cold shock	SMALL. Cold shock has been satisfactorily mitigated at operating nuclear plants with once-through cooling systems, has not endangered fish populations or been found to be a problem at operating nuclear power plants with cooling towers or cooling ponds, and is not expected to be a problem during the license renewal term.	4.2.2.1.5/4-18
18. Thermal plume barrier to migrating fish	SMALL. Thermal plumes have not been found to be a problem at operating nuclear power plants and are not expected to be a problem during the license renewal term.	4.2.2.1.6/4-19
19. Distribution of aquatic organisms	SMALL. Thermal discharge may have localized effects, but is not expected to affect the larger geographical distribution of aquatic organisms.	4.2.2.1.6/4-19
20. Premature emergence of aquatic insects	SMALL. Premature emergence has been found to be a localized effect at some operating nuclear power plants, but has not been a problem and is not expected to be a problem during the license renewal term.	4.2.2.1.7/4-20
21. Gas supersaturation (gas bubble disease)	SMALL. Gas supersaturation was a concern at a small number of operating nuclear power plants with once-through cooling systems, but has been satisfactorily mitigated. It has not been found to be a problem at operating nuclear power plants with cooling towers or cooling ponds and is not expected to be a problem during the license renewal term.	4.2.2.1.8/4-21

Table 4-2 (Cont'd)
Category 1 and NA Issues That Apply to
North Anna Power Station Units 1 & 2 (NAPS)[a]

Issue	NRC Findings[b]	GEIS Reference (Section/Page)
22. Low dissolved oxygen in the discharge	SMALL. Low dissolved oxygen has been a concern at one nuclear power plant with a once-through cooling system, but has been effectively mitigated. It has not been found to be a problem at operating nuclear power plants with cooling towers or cooling ponds and is not expected to be a problem during the license renewal term.	4.2.2.1.9/4-23
23. Losses from predation, parasitism, and disease among organisms exposed to sublethal stresses	SMALL. These types of losses have not been found to be a problem at operating nuclear power plants and are not expected to be a problem during the license renewal term.	4.2.2.1.10/4-24
24. Stimulation of nuisance organisms (e.g., shipworms)	SMALL. Stimulation of nuisance organisms has been satisfactorily mitigated at the single nuclear power plant with a once-through cooling system where previously it was a problem. It has not been found to be a problem at operating nuclear power plants with cooling towers or cooling ponds and is not expected to be a problem during the license renewal term.	4.2.2.1.11/4-25
	Groundwater Use and Quality	
32. Groundwater use conflicts (portable and service water; plants that use <100 gpm).	SMALL. Plants using less than 100 gpm are not expected to cause any groundwater use conflicts.	4.8.2.1/4-119
	Terrestrial Resources	
45. Power line right-of-way management (cutting and herbicide application)	SMALL. The impacts of right-of-way maintenance on wildlife are expected to be of small significance at all sites.	4.5.6.1/4-71
46. Bird collisions with power lines	SMALL. Impacts are expected to be of small significance at all sites.	4.5.6.2/4-74
47. Impacts of electromagnetic fields on flora and fauna (plants, agricultural crops, honeybees, wildlife, livestock)	SMALL. No significant impacts of electromagnetic fields on terrestrial flora and fauna have been identified. Such effects are not expected to be a problem during the license renewal term.	4.5.6.3/4-77

Table 4-2 (Cont'd)
Category 1 and NA Issues That Apply to
North Anna Power Station Units 1 & 2 (NAPS)[a]

Issue	NRC Findings[b]	GEIS Reference (Section/Page)
48. Floodplains and wetlands on power line right-of-way	SMALL. Periodic vegetation control is necessary in forested wetlands underneath power lines and can be achieved with minimal damage to the wetland. No significant impact is expected at any nuclear power plant during the license renewal term.	4.5.7/4-81
	Air Quality	
51. Air quality effects of transmission lines	SMALL. Production of ozone and oxides of nitrogen is insignificant and does not contribute measurably to ambient levels of these gases.	4.5.2/4-62 3.2/3-1
	Land Use	
52. Onsite land use	SMALL. Projected onsite land-use changes required during refurbishment and the renewal period would be a small fraction of any nuclear power plant site and would involve land that is controlled by the applicant.	3.2/3-1
53. Power line right-of-way land-use impacts	SMALL. Ongoing use of power line rights-of-way would continue with no change in restrictions. The effects of these restrictions are of small significance.	4.5.3/4-62
	Human Health	
58. Noise	SMALL. Noise has not been found to be a problem at operating plants and is not expected to be a problem at any plant during the license renewal term.	4.3.7/4-49
60. Electromagnetic fields, chronic effects	UNCERTAIN. Biological and physical studies of 60-Hz electromagnetic fields have not found consistent evidence linking harmful effects with field exposure. However, research is continuing in this area and a consensus scientific view has not been reached.	4.5.4.2/4-67
61. Radiation exposures to public (license renewal term)	SMALL. Radiation doses to the public will continue at current levels associated with normal operations.	4.6.2/4-87
62. Occupational radiation exposures (license renewal term)	SMALL. Projected maximum occupational doses during the license renewal term are within the range of doses experienced during normal operations and normal maintenance outages, and would be well below regulatory limits.	4.6.3/4-95

Table 4-2 (Cont'd)
Category 1 and NA Issues That Apply to
North Anna Power Station Units 1 & 2 (NAPS)[a]

Issue	NRC Findings[b]	GEIS Reference (Section/Page)
	Socioeconomics	
64. Public services: public safety, social services, and tourism and recreation	SMALL. Impacts to public safety, social services, and tourism and recreation are expected to be of small significance at all sites.	4.7.3/4-104 (renewal - public services) 4.7.3.3/4-106 (renewal - safety) 4.7.3.4/4-107 (renewal - social) 4.7.3.6/4-107 (renewal - tourism, recreation)
67. Public services: education (license renewal term)	SMALL. Only impacts of small significance are expected.	4.7.3.1/4-106
73. Aesthetic impacts (license renewal term)	SMALL. No significant impacts are expected during the license renewal term.	4.7.6/4-111
74. Aesthetic impacts of transmission lines (license renewal term)	SMALL. No significant impacts are expected during the license renewal term.	4.5.8/4-83
	Postulated Accidents	
75. Design-basis accidents	SMALL. The NRC staff has concluded that the environmental impacts of design-basis accidents are of small significance for all plants.	5.3.2/5-11 (design basis) 5.5.1/5-114 (summary)
	Uranium Fuel Cycle and Waste Management	
77. Offsite radiological impacts (individual effects from other than the disposal of spent fuel and high-level waste)	SMALL. Offsite impacts of the uranium fuel cycle have been considered by the Commission in Table S-3 of this part. Based on information in the GEIS, impacts on individuals from radioactive gaseous and liquid releases, including radon-222 and technetium-99, are small.	6.2/6-8

Table 4-2 (Cont'd)
Category 1 and NA Issues That Apply to
North Anna Power Station Units 1 & 2 (NAPS)[a]

Issue	NRC Findings[b]	GEIS Reference (Section/Page)
78. Offsite radiological impacts (collective effects)	The 100-year environmental dose commitment to the U.S. population from the fuel cycle, high-level waste, and spent-fuel disposal is calculated to be about 14,800 person-rem, or 12 cancer fatalities, for each additional 20-year power reactor operating term. Much of this, especially the contribution of radon releases from mines and tailing piles, consists of tiny doses summed over large populations. This same dose calculation can theoretically be extended to include many tiny doses over additional thousands of years, as well as doses outside the U.S. The result of such a calculation would be thousands of cancer fatalities from the fuel cycle, but this result assumes that even tiny doses have some statistical adverse health effect, which will not ever be mitigated (for example, no cancer cure in the next thousand years), and that these dose projections over thousands of years are meaningful. However, these assumptions are questionable. In particular, science cannot rule out the possibility that there will be no cancer fatalities from these tiny doses. For perspective, the doses are very small fractions of regulatory limits, and even smaller fractions of natural background exposure to the same populations. Nevertheless, despite all the uncertainty, some judgment as to the regulatory National Environmental Policy Act (NEPA) implications of these matters should be made and it makes no sense to repeat the same judgment in every case. Even taking the uncertainties into account, the Commission concludes that these impacts are acceptable in that these impacts would not be sufficiently large to require the NEPA conclusion, for any plant, that the option of extended operation under 10 CFR 54 should be eliminated. Accordingly, while the Commission has not assigned a single level of significance for the collective effects of the fuel cycle, this issue is considered Category 1.	Not in GEIS

Table 4-2 (Cont'd)
Category 1 and NA Issues That Apply to
North Anna Power Station Units 1 & 2 (NAPS)[a]

Issue	NRC Findings[b]	GEIS Reference (Section/Page)
79. Offsite radiological impacts (spent fuel and high-level waste disposal)	For the high-level waste and spent-fuel disposal component of the fuel cycle, there are no current regulatory limits for offsite releases of radionuclides for the current candidate repository site. However, if we assume that limits are developed along the lines of the 1995 National Academy of Sciences (NAS) report, "Technical Bases for Yucca Mountain Standards," and that, in accordance with the Commission's Waste Confidence Decision, 10 CFR 51.23, a repository can and likely will be developed at some site that will comply with such limits, peak doses to virtually all individuals will be 100 millirem per year or less. However, while the Commission has reasonable confidence that these assumptions will prove correct, there is considerable uncertainty since the limits are yet to be developed, no repository application has been completed or reviewed, and uncertainty is inherent in the models used to evaluate possible pathways to the human environment. The NAS report indicated that 100 millirem per year should be considered as a starting point for limits for individual doses, but notes that some measure of consensus exists among national and international bodies that the limits should be a fraction of the 100 millirem per year. The lifetime individual risk from the 100-millirem annual dose limit is about 3×10^{-3}. Estimating cumulative doses to populations over thousands of years is more problematic. The likelihood and consequences of events that could seriously compromise the integrity of a deep geologic repository were evaluated by the U.S. Department of Energy in the "Final Environmental Impact Statement: Management of Commercially Generated Radioactive Waste," October 1980. The evaluation estimated the 70-year whole-body dose commitment to the maximum individual and to the regional population resulting from several modes of breaching a reference repository in the year of closure, after 1,000 years, after 100,000 years, and after 100,000,000 years. Subsequently, NRC and other federal agencies have expended considerable effort to develop models for the design and for the licensing of a high-level waste repository, especially for the candidate repository at Yucca Mountain. More meaningful estimates of doses to the population may be possible in the future as more is understood about the performance of the proposed Yucca Mountain repository. Such estimates would involve	Not in GEIS

Table 4-2 (Cont'd)
Category 1 and NA Issues That Apply to
North Anna Power Station Units 1 & 2 (NAPS)[a]

Issue	NRC Findings[b]	GEIS Reference (Section/Page)
	very great uncertainty, especially with respect to cumulative population doses over thousands of years. The standard proposed by the NAS is a limit on maximum individual dose. The relationship of potential new regulatory requirements, based on the NAS report, and cumulative population impacts has not been determined, although the report articulates the view that protection of individuals will adequately protect the population for a repository at Yucca Mountain. However, the U.S. Environmental Protection Agency's (EPA's) generic repository standards in 40 CFR 191 generally provide an indication of the order of magnitude of cumulative risk to the population that could result from the licensing of a Yucca Mountain repository, assuming the ultimate standards will be within the range of standards now under consideration. The standards in 40 CFR 191 protect the population by imposing "containment requirements" that limit the cumulative amount of radioactive material released over 10,000 years. The cumulative release limits are based on EPA's population impact goal of 1,000 premature cancer deaths worldwide for a 100,000 metric tonne (MTHM) repository. Nevertheless, despite all the uncertainty, some judgment as to the regulatory NEPA implications of these matters should be made and it makes no sense to repeat the same judgment in every case. Even taking the uncertainties into account, the Commission concludes that these impacts are acceptable in that these impacts would not be sufficiently large to require the NEPA conclusion, for any plant, that the option of extended operation under 10 CFR 54 should be eliminated. Accordingly, while the Commission has not assigned a single level of significance for the impacts of spent fuel and high-level waste disposal, this issue is considered Category 1.	
80. Nonradiological impacts of the uranium fuel cycle	SMALL. The nonradiological impacts of the uranium fuel cycle resulting from the renewal of an operating license for any plant are small.	6.2.2.6/6-20 (land use) 6.2.2.7/6-20 (water use) 6.2.2.8/6-21 (fossil fuel) 6.2.2.9/6-21 (chemical)

Table 4-2 (Cont'd)
Category 1 and NA Issues That Apply to
North Anna Power Station Units 1 & 2 (NAPS)[a]

Issue	NRC Findings[b]	GEIS Reference (Section/Page)
81. Low-level waste storage and disposal	SMALL. The comprehensive regulatory controls that are in place and the low public doses being achieved at reactors ensure that the radiological impacts to the environment will remain small during the term of a renewed license. The maximum additional onsite land that may be required for low-level waste storage during the term of a renewed license and associated impacts will be small. Nonradiological impacts on air and water will be negligible. The radiological and nonradiological environmental impacts of long-term disposal of low-level waste from any individual plant at licensed sites are small. In addition, the Commission concludes that there is reasonable assurance that sufficient low-level waste disposal capacity will be made available when needed for facilities to be decommissioned consistent with NRC decommissioning requirements.	6.4.2/6-36 ("low-level" definition) 6.4.3/6-37 (low-level volume) 6.4.4/6-48 (renewal effects)
82. Mixed waste storage and disposal	SMALL. The comprehensive regulatory controls and the facilities and procedures that are in place ensure proper handling and storage, as well as negligible doses and exposure to toxic materials for the public and the environment at all plants. License renewal will not increase the small continuing risk to human health and the environment posed by mixed waste at all plants. The radiological and nonradiological environmental impacts of long-term disposal of mixed waste from any individual plant at licensed sites are small. In addition, the Commission concludes that there is reasonable assurance that sufficient mixed waste disposal capacity will be made available when needed for facilities to be decommissioned consistent with NRC decommissioning requirements.	6.4.5/6-63
83. Onsite spent fuel	SMALL. The expected increase in the volume of spent fuel from an additional 20 years of operation can be safely accommodated onsite with small environmental effects through dry or pool storage at all plants, if a permanent repository or monitored retrievable storage is not available.	6.4.6/6-70
84. Nonradiological waste	SMALL. No changes to generating systems are anticipated for license renewal. Facilities and procedures are in place to ensure continued proper handling and disposal at all plants.	6.5/6-86

Table 4-2 (Cont'd)
Category 1 and NA Issues That Apply to
North Anna Power Station Units 1 & 2 (NAPS)[a]

Issue	NRC Findings[b]	GEIS Reference (Section/Page)
85. Transportation	SMALL. The impacts of transporting spent fuel enriched up to 5 percent uranium-235 with average burnup for the peak rod to current levels approved by NRC up to 62,000 MWd/MTU and the cumulative impacts of transporting high-level waste to a single repository, such as Yucca Mountain, Nevada, are found to be consistent with the impact values contained in 10 CFR 51.52(c), Summary Table S-4-Environmental Impact of Transportation of Fuel and Waste to and from One Light-Water-Cooled Nuclear Reactor. If fuel enrichment or burnup conditions are not met, the applicant must submit an assessment of the implications for the environmental impact values reported in § 51.52.	Footnote c
86. Radiation doses (decommissioning)	SMALL. Doses to the public will be well below applicable regulatory standards, regardless of which decommissioning method is used. Occupational doses would increase no more than 1 man-rem caused by buildup of long-lived radionuclides during the license renewal term.	7.3.1/7-15
87. Waste management (decommissioning)	SMALL. Decommissioning at the end of a 20-year license renewal period would generate no more solid wastes than at the end of the current license term. No increase in the quantities of Class C or greater-than-Class-C wastes would be expected.	7.3.2/7-19 (impacts) 7.4/7-25 (conclusions)
	Decommissioning	
88. Air quality (decommissioning)	SMALL. Air quality impacts of decommissioning are expected to be negligible, either at the end of the current operating term or at the end of the license renewal term.	7.3.3/7-21 (air) 7.4/7-25 (conclusion)
89. Water quality (decommissioning)	SMALL. The potential for significant water quality impacts from erosion or spills is no greater whether decommissioning occurs after a 20-year license renewal period or after the original 40-year operation period, and measures are readily available to avoid such impacts.	7.3.4/7-21 (water) 7.4/7-25 (conclusion)
90. Ecological resources (decommissioning)	SMALL. Decommissioning after either the initial operating period or after a 20-year license renewal period is not expected to have any direct ecological impacts.	7.3.5/7-21 (ecological) 7.4/7-25 (conclusion)

Table 4-2 (Cont'd)
Category 1 and NA Issues That Apply to
North Anna Power Station Units 1 & 2 (NAPS)[a]

Issue	NRC Findings[b]	GEIS Reference (Section/Page)
Environmental Justice		
92. Environmental justice	NONE. The need for and the content of an analysis of environmental justice will be addressed in plant-specific reviews.	Not in GEIS

a. NRC listed the issues in Table B-1 of 10 CFR 51 Appendix B. Dominion added issue numbers for expediency.
b. NRC has defined "SMALL" to mean that, for the issue, environmental effects are not detectable or are so minor that they will neither destabilize nor noticeably alter any important attribute of the resource. For purposes of assessing radiological impacts, NRC has concluded that those impacts that do not exceed permissible levels in the NRC regulations are considered small. (10 CFR 51 Appendix B, Table B-1, footnote 3).
c. NRC published, on September 3, 1999, a GEIS addendum (Ref. 4.0-3) in support of its rulemaking that re-categorized Issue 85 from "2" to "1".

CFR = Code of Federal Regulations
EPA = U.S. Environmental Protection Agency
GEIS = Generic Environmental Impact Statement (Ref. 4.0-1)
Hz = Hertz
NA = Not applicable. NRC determined that its categorization ("1" or "2") and its impact findings definitions ("SMALL," "MODERATE," "LARGE") do not apply to two issues (Issues 60 and 92)
NAS = National Academy of Sciences
NEPA = National Environmental Policy Act
NRC = U.S. Nuclear Regulatory Commission

Table 4-3
Mean Monthly Water Temperatures at Dike 3,
Lake Anna, August 1983 - December 1985

	Year			
Month	**1983**	**1984**	**1985**	**Means of Means**
January	--	45.0ºF	50.7ºF	47.9ºF
February	--	48.0ºF	47.7ºF	47.9ºF
March	--	54.0ºF	55.6ºF	54.8ºF
April	--	58.9ºF	63.7ºF	61.3ºF
May	--	68.4ºF	73.2ºF	70.8ºF
June	--	78.3ºF	79.3ºF	78.8ºF
July	--	81.5ºF	83.7ºF	82.6ºF
August	88.2ºF	81.3ºF	83.9ºF	84.5ºF
September	81.5ºF	75.4ºF	81.9ºF	79.6ºF
October	73.0ºF	68.2ºF	73.9ºF	71.7ºF
November	63.1ºF	62.6ºF	64.4ºF	63.4ºF
December	54.9ºF	57.0ºF	52.7ºF	54.9ºF

Source: Ref. 4.4-1.

Table 4-4
Results of Induced Current Analysis

Transmission Line	Voltage (kV)	Limiting Case Electric Field Strength (kV/meter)	Limiting Case Induced Current (milliamperes)
255, South Anna NUG	230	4.35	3.10
573, Morrisville	500	6.95	4.95
575, Ladysmith	500	6.40	4.56
576, Midlothian	500	6.68	4.77

Table 4-5
Base Case Benefit (in dollars)[a,b]

Parameter	Value
Offsite annual dose (person-rem)	25.3990
Offsite annual economic cost	$48,846
Offsite exposure cost savings (present dollar value)	$546,735
Offsite economic cost savings (present dollar value)	$525,721
Total offsite cost savings	**$1,072,455**
Onsite short-term exposure cost (best estimate)	$2,487
Onsite long-term exposure cost (best estimate)	$10,839
Cleanup/decontamination cost savings	$406,466
Total onsite cost savings (without replacement power)	**$419,791**
Replacement power cost	$276,229
Total onsite cost (with replacement power)	**$696,021**
Total cost (onsite + replacement power + offsite)	**$1,768,476**

a. Refer to text in Section 4.20 for discussions of how these numbers are calculated.
b. The benefit numbers in this table have not yet been doubled to account for the External Events contribution. For example, the total offsite cost savings is $1.1 million, so doubling it yields a maximum benefit of $2.2 million for containment/Level 2 improvements.

Table 4-6
Summary of North Anna Power Station SAMAs Considered in Benefit/Cost Analysis[a]

SAMA No.	Potential Improvement	Discussion	Reduction in CDF (bounding)	Reduction in Person-Rem Offsite (bounding)	Benefit (bounding)	Estimated Cost	Conclusion	Cost Estimate and Basis for Conclusion
10	Create an independent RCP seal injection system, with dedicated diesel	Would add redundancy to RCP seal cooling alternatives, reducing CDF from loss of seal cooling or SBO.	9.6%	0.3%	$140k	>2 x benefit	Screen out	Screening case SLO determined the maximum benefit to be $140k. The cost of an independent pump, diesel and piping connection to the RCP seal injection would likely be an order of magnitude greater than the possible benefit. Not cost beneficial; cost is estimated to exceed twice the benefit.
11	Create an independent RCP seal injection system, without dedicated diesel	Would add redundancy to RCP seal cooling alternatives, reducing CDF from loss of seal cooling, but not SBO.	9.6%	0.3%	$140k	>2 x benefit	Screen out	Screening case SLO determined the maximum possible benefit of removing all seal LOCAs to be $140k. Without the diesel described in case 10, the actual benefit would be much less. The cost of a new pump, piping, and connection to the seal injection system is expected to be much greater than twice the possible benefit. Not cost beneficial; cost is estimated to exceed twice the benefit.
14	Install improved RCP seals	RCP seal O-rings constructed of improved materials would reduce chances of RCP seal LOCA.	9.6%	0.3%	$140k	>2 x benefit	Screen out	Screening case SLO determined the maximum possible benefit of removing all seal LOCAs to be $140k. The cost of replacing the seals would likely be an order of magnitude larger than the possible benefit. Not cost beneficial; cost is estimated to exceed twice the benefit.

Table 4-6 (Cont'd)
Summary of North Anna Power Station SAMAs Considered in Benefit/Cost Analysis[a]

SAMA No.	Potential Improvement	Discussion	Reduction in CDF (bounding)	Reduction in Person-Rem Offsite (bounding)	Benefit (bounding)	Estimated Cost	Conclusion	Cost Estimate and Basis for Conclusion
21	Loss of CCW or SW procedural enhancements	The suggested improvements in the reference documents include staggering CCW pump operation when SW fails, cross-tying pumps, or shedding CCW loads to extend heatup time.	0.00%	0.00%	$0	>2 x benefit	Screen out	The cross-tied system already exists at NAPS. The other options would not provide any significant benefit because, although they might delay system failure slightly, they would not prevent it. Not cost beneficial; cost is estimated to exceed twice the benefit.
23	Improve SW pump alignments when a header is out for maintenance	An optimal alignment would improve SW availability during these periods.	0.2%	0.02%	$3k	>2 x benefit	Screen out	Analysis case SWH determined the maximum benefit to be $3k. Not cost beneficial; cost is estimated to exceed twice the benefit.
25	Provide a non-safety related, redundant train of switchgear ventilation	Provide a non-safety-related, redundant train of switchgear ventilation.	7.4%	1.0%	$123k	>2 x benefit	Screen out	Screening case HVC determined the maximum benefit to be $123k. It is judged that the cost of a new train of switchgear with heat removal would be at least an order of magnitude higher than this in cost. Not cost beneficial; cost is estimated to exceed twice the benefit.
27	Add a switchgear room high temp alarm	Improve diagnosis of a loss of switchgear HVAC.	0.9%	0.1%	$14k	>2 x benefit	Screen out	Analysis case HVA determined the maximum benefit to be $14k. The minimum cost is judged to be $100k. Not cost beneficial; cost is estimated to exceed twice the benefit.

Table 4-6 (Cont'd)
Summary of North Anna Power Station SAMAs Considered in Benefit/Cost Analysis[a]

SAMA No.	Potential Improvement	Discussion	Reduction in CDF (bounding)	Reduction in Person-Rem Offsite (bounding)	Benefit (bounding)	Estimated Cost	Conclusion	Cost Estimate and Basis for Conclusion
30	Install containment spray throttle valves	Can extend the time over which water remains in the RWST, when full containment spray flow is not needed.	0.2%	0.1%	$4k	>2 x benefit	Screen out	Screening case CSP determined the maximum benefit to be $4k. Not cost beneficial; cost is estimated to exceed twice the benefit.
32	Develop an enhanced containment spray system	Would provide a redundant source of water to the containment to control containment pressure, when used in conjunction with containment heat removal.	0.2%	0.1%	$4k	>2 x benefit	Screen out	Screening case CSP determined the maximum benefit to be $4k. Not cost beneficial; cost is estimated to exceed twice the benefit.
33	Provide a dedicated existing containment spray system	Identical to the previous concept, except that one of the existing spray loops would be used instead of developing a new spray system.	0.2%	0.1%	$4k	>2 x benefit	Screen out	Screening case CSP determined the maximum benefit to be $4k. Not cost beneficial; cost is estimated to exceed twice the benefit.
34	Install a containment vent large enough to remove ATWS decay heat	Assuming injection is available, would provide alternative decay heat removal in an ATWS.	0.7%	0.04%	$11k	>2 x benefit	Screen out	Screening case DHR determined the maximum benefit to be $11k. Not cost beneficial; cost is estimated to exceed twice the benefit.

Table 4-6 (Cont'd)
Summary of North Anna Power Station SAMAs Considered in Benefit/Cost Analysis[a]

SAMA No.	Potential Improvement	Discussion	Reduction in CDF (bounding)	Reduction in Person-Rem Offsite (bounding)	Benefit (bounding)	Estimated Cost	Conclusion	Cost Estimate and Basis for Conclusion
35	Install a filtered containment vent to remove decay heat	Assuming injection is available (non-ATWS sequences), would provide alternate decay heat removal with the released fission products being scrubbed.	0.7%	1.2%	$25k	>2 x benefit	Screen out	Screening case DHR shows the maximum possible benefit of a containment vent as $11k. Screening case SCB shows the maximum possible benefit of the filtering of the fission products in the containment (all non-isolation releases) to be 14k. The combined benefit is $25k. Not cost beneficial; cost is estimated to exceed twice the benefit.
36	Install an unfiltered hardened containment vent	Provides an alternate decay heat removal method (non-ATWS), which is not filtered.	0.7%	0.04%	$11k	>2 x benefit	Screen out	Screening case DHR determined the maximum benefit to be $11k. Not cost beneficial; cost is estimated to exceed twice the benefit.
37	Create/ enhance hydrogen igniters with independent power supply.	Use either a new, independent power supply, a non-safety grade portable generator, existing station batteries, or existing AC/DC independent power supplies such as the security system diesel. Would reduce hydrogen detonation at lower cost.	0.00%	0.1%	$2k	>2 x benefit	Screen out	Analysis case HYD determined the maximum benefit of eliminating containment failure due to hydrogen burns to be $2k. Not cost beneficial; cost is estimated to exceed twice the benefit.

Table 4-6 (Cont'd)
Summary of North Anna Power Station SAMAs Considered in Benefit/Cost Analysis[a]

SAMA No.	Potential Improvement	Discussion	Reduction In CDF (bounding)	Reduction In Person-Rem Offsite (bounding)	Benefit (bounding)	Estimated Cost	Conclusion	Cost Estimate and Basis for Conclusion
38	Create a passive hydrogen ignition system	Reduce hydrogen detonation potential without requiring electric power.	0.00%	0.1%	$2k	>2 x benefit	Screen out	Analysis case HYD determined the maximum benefit of eliminating containment failure due to hydrogen burns to be $2k. Not cost beneficial; cost is estimated to exceed twice the benefit.
39	Create a giant concrete crucible with heat removal potential under the basemat to contain molten debris	A molten core escaping from the vessel would be contained within the crucible. The water cooling mechanism would cool the molten core, preventing a melt-through.	0.00%	100%	$2.2 million	>2 x benefit	Screen out	The baseline analysis shows a maximum possible benefit of removing all offsite releases to be $2.2 million. It is judged that this SAMA would likely have a cost an order of magnitude larger than this possible benefit. Not cost beneficial; cost is estimated to exceed twice the benefit.
40	Create a water cooled rubble bed on the pedestal	This rubble bed would contain a molten core dropping onto the pedestal, and would allow the debris to be cooled.	0.00%	100%	$2.2 million	>2 x benefit	Screen out	The baseline analysis shows a maximum possible benefit of removing all offsite releases to be $2.2 million. It is judged that this SAMA would likely have a cost an order of magnitude larger than this possible benefit. Not cost beneficial; cost is estimated to exceed twice the benefit.
42	Enhance fire protection system and/or standby gas treatment system hardware and procedures	Improve fission product scrubbing in severe accidents.	0.00%	1.1%	$14k	>2 x benefit	Screen out	Screening case SCB shows the maximum possible benefit of the filtering of the fission products in the containment to be $14k. It is judged that this SAMA would be at a greater cost than this benefit when all necessary hardware and procedural changes are included. Not cost beneficial; cost is estimated to exceed twice the benefit.

Table 4-6 (Cont'd)
Summary of North Anna Power Station SAMAs Considered in Benefit/Cost Analysis[a]

SAMA No.	Potential Improvement	Discussion	Reduction In CDF (bounding)	Reduction In Person-Rem Offsite (bounding)	Benefit (bounding)	Estimated Cost	Conclusion	Cost Estimate and Basis for Conclusion
43	Create a reactor cavity flooding system	Would enhance debris coolability, reduce core concrete interaction and provide fission product scrubbing.	0.00%	0.00%	$0	>2 x benefit	Screen out	Analysis case DEB found no benefit in the NAPS level 2 analysis for flooding the reactor cavity. Not cost beneficial; cost is estimated to exceed twice the benefit.
44	Creating other options for reactor cavity flooding	Flood cavity via systems such as diesel driven fire pumps.	0.00%	0.00%	$0	>2 x benefit	Screen out	Analysis case DEB found no benefit in the NAPS level 2 analysis for flooding the reactor cavity. Not cost beneficial; cost is estimated to exceed twice the benefit.
46	Provide a core debris control system	Would prevent the direct core debris attack of the primary containment steel shell by erecting a barrier between the seal table and containment shell.	0.00%	0.00%	$0	>2 x benefit	Screen out	This failure mode was not found to be a concern in the NAPS level 2 analysis, so it is judged to have a negligible benefit.

Table 4-6 (Cont'd)
Summary of North Anna Power Station SAMAs Considered in Benefit/Cost Analysis[a]

SAMA No.	Potential Improvement	Discussion	Reduction In CDF (bounding)	Reduction In Person-Rem Offsite (bounding)	Benefit (bounding)	Estimated Cost	Conclusion	Cost Estimate and Basis for Conclusion
47	Create a core melt source reduction system (COMSORS)	Place enough glass underneath the reactor vessel such that a molten core falling on the glass would melt and combine with the material. Subsequent spreading and heat removal from the vitrified compound would be facilitated, and concrete attack would not occur (such benefits are theorized in the reference).	0.00%	100%	$2.2 million	>2 x benefit	Screen out	The baseline analysis shows a maximum possible benefit of removing all offsite releases to be $2.2 million. It is judged that this SAMA would likely have a cost an order of magnitude larger than this possible benefit. Not cost beneficial; cost is estimated to exceed twice the benefit.
48	Provide containment inerting capability	Would prevent combustion of hydrogen and carbon monoxide gases	0.00%	0.1%	$2k	>2 x benefit	Screen out	Analysis case HYD determined the maximum benefit of eliminating containment failure due to hydrogen burns to be $2k. Not cost beneficial; cost is estimated to exceed twice the benefit.
49	Use fire water spray pump for containment spray	Redundant containment spray method without high cost.	0.2%	0.1%	$4k	>2 x benefit	Screen out	Screening case CSP determined the maximum benefit to be $4k. Not cost beneficial; cost is estimated to exceed twice the benefit.
50	Install a passive containment spray system	Containment spray benefits at a very high reliability, and without support systems.	0.2%	0.1%	$4k	>2 x benefit	Screen out	Screening case CSP determined the maximum benefit to be $4k. Not cost beneficial; cost is estimated to exceed twice the benefit.

Table 4-6 (Cont'd)

Summary of North Anna Power Station SAMAs Considered in Benefit/Cost Analysis[a]

SAMA No.	Potential Improvement	Discussion	Reduction In CDF (bounding)	Reduction In Person-Rem Offsite (bounding)	Benefit (bounding)	Estimated Cost	Conclusion	Cost Estimate and Basis for Conclusion
54	Provide a reactor vessel exterior cooling system	Potential to cool a molten core before it causes vessel failure, if the lower head can be submerged in water.	0.00%	1.1%	$14k	>2 x benefit	Screen out	Screening case SCB shows the maximum possible benefit of the filtering of the fission products in the containment to be $14k. It is judged that this SAMA would be at a greater cost than this benefit when all necessary hardware and procedural changes are included. Not cost beneficial; cost is estimated to exceed twice the benefit.
55	Create another building, maintained at a vacuum to be connected to containment	In an accident, connecting the new building to containment would depressurize containment and reduce any fission product release.	0.00%	100%	$2.2 million	>2 x benefit	Screen out	The baseline analysis shows a maximum possible benefit of removing all offsite releases to be $2.2 million. It is judged that this SAMA would likely have a cost an order of magnitude larger than this possible benefit. Not cost beneficial; cost is estimated to exceed twice the benefit.
60	Provide additional DC battery capability	Would ensure longer battery capability during a SBO, reducing frequency of long term SBO sequences.	7.3%	35.1%	$876k	>2 x benefit	Screen out	Screening case BAT determined the maximum benefit if batteries are always successful to be $876k. A redundant battery could be installed to provide the backup power requirements indicated and to remove non-safety related loads from the current batteries. This 'black' battery would be similar in design and construction to the one already installed at Surry. The present day cost of that installation including the purchase of a new battery set, chargers, inverters, building, ventilation, etc. would be $2-5M. Not cost beneficial; cost is estimated to exceed twice the benefit.

Table 4-6 (Cont'd)
Summary of North Anna Power Station SAMAs Considered in Benefit/Cost Analysis[a]

SAMA No.	Potential Improvement	Discussion	Reduction In CDF (bounding)	Reduction In Person-Rem Offsite (bounding)	Benefit (bounding)	Estimated Cost	Conclusion	Cost Estimate and Basis for Conclusion
61	Use fuel cells instead of lead-acid batteries	Extend DC power availability in a SBO.	2.0%	0.1%	$29k	>2 x benefit	Screen out	Analysis case BCH calculated the maximum benefit if batteries never drain to be $29k. The System 80+ submittal (References 16 and 17) estimated the cost to be $2 million. The cost to an existing plant would be larger. Not cost beneficial; cost is estimated to exceed twice the benefit.
64	Alternate battery charging capability	Provide a portable diesel-driven battery charger.	2.0%	0.1%	$29k	>2 x benefit	Screen out	Analysis case BCH determined the maximum benefit of extended battery life during an accident to be $29k. The total battery load of the DC emergency buses during a four hour SBO event would require a 50-kw battery charger. A portable unit with appropriate disconnects on the batteries for hook up during full power operation could be installed. The hookup would need to be brought out the alleyways where the diesel would be located when needed. Temporary cables would also be provided. Total cost for the diesel and plant modifications for its use $1.5-3M. Not cost beneficial; cost is estimated to exceed twice the benefit.

Table 4-6 (Cont'd)
Summary of North Anna Power Station SAMAs Considered in Benefit/Cost Analysis[a]

SAMA No.	Potential Improvement	Discussion	Reduction In CDF (bounding)	Reduction In Person-Rem Offsite (bounding)	Benefit (bounding)	Estimated Cost	Conclusion	Cost Estimate and Basis for Conclusion
69	Develop procedures to repair or change out failed 4kV breakers	Offers a recovery path from a failure of breakers that perform transfer of 4.16 kV non-emergency buses from unit station service transformers to system station service transformers, leading to loss of emergency AC power (i.e., in conjunction with failures of the diesel generators).	0.7%	3.6%	$88k	>2 x benefit	Screen out	The concept of capturing significant benefit through generation of a procedure is not realistic because the maintenance crews are already trained on the plant procedures for failed breakers. Therefore, the only portion of this SAMA given merit is the hardware portion (i.e., prestaged replacement breakers). Analysis case 4KV determined the maximum benefit to be $88k if half of all 4kV breaker failures could be replaced in the timeframe considered in the PRA. The cost would be much greater than the actual benefit in order to have the many necessary breakers prestaged for this procedure to be effective. Not cost-beneficial; cost of purchasing, sheltering, and maintaining multiple prestaged 4kV breakers would exceed twice the benefit.
70	Emphasize steps in recovery of offsite power after a SBO	Reduced human error probability of offsite power recovery.	4.4%	0.4%	$72k	>2 x benefit	Screen out	Analysis case OPR determined the maximum benefit to be $72k. The case was calculated using a 25% reduction in offsite power non-recovery terms. It is judged that this benefit is very optimistic given that training is already provided for offsite power recovery, and the fact that failure to recover offsite power is likely to be governed by actual failures in the grid and not personnel failure. This is especially true for LOOP caused by external events initiators. Without the external events effect, the benefit is $35k. Not cost beneficial; cost is estimated to exceed twice the true obtainable benefit.

Table 4-6 (Cont'd)

Summary of North Anna Power Station SAMAs Considered in Benefit/Cost Analysis[a]

SAMA No.	Potential Improvement	Discussion	Reduction In CDF (bounding)	Reduction In Person-Rem Offsite (bounding)	Benefit (bounding)	Estimated Cost	Conclusion	Cost Estimate and Basis for Conclusion
73	Install gas turbine generators	Improve onsite AC power reliability.	19.6%	1.8%	$318k	>2 x benefit	Screen out	It is not clear if the SBO diesel already serves the function proposed by this generator. If not, a combustion turbine could be located near the switchyard and use existing transmission lines to connect to the station. There is no ready supply of gas at North Anna, so storage facility would need to be constructed along with providing the necessary services to make the unit operate. Total cost for 5 MW machine installed and connected with a gas storage facility is $20-30M. Screening case OSP determined the maximum benefit to be $318k. Not cost beneficial; cost is estimated to exceed twice the benefit.
77	Provide a connection to alternate offsite power source (the nearby dam)	Increase offsite power redundancy.	19.6%	1.8%	$318k	>2 x benefit	Screen out	Screening case OSP determined the maximum benefit to be $318k. The main dam is approximately 10 miles by roadway from the power station. A dedicated transmission line with appropriate switchgear would need to be installed. The switchgear would allow the normal feeds at the dam and at the station switchyard to be disconnected and allow the dedicated line to be put in to service manually. Order of magnitude estimate is $2-5 Million. Not cost beneficial; cost is estimated to exceed twice the benefit.

Table 4-6 (Cont'd)
Summary of North Anna Power Station SAMAs Considered in Benefit/Cost Analysis[a]

SAMA No.	Potential Improvement	Discussion	Reduction In CDF (bounding)	Reduction In Person-Rem Offsite (bounding)	Benefit (bounding)	Estimated Cost	Conclusion	Cost Estimate and Basis for Conclusion
81	Put a fast acting MG output breaker on both units	With a fast-acting breaker, a turbine runback would be possible, reducing the likelihood of a reactor trip in some cases. Currently, only one unit has this.	1.7%	0.2%	$29k	>2 x benefit	Screen out	Analysis case MGB determined the maximum benefit to be less than $29k. Not cost beneficial; cost is estimated to exceed twice the benefit.
84	Improved SGTR coping abilities	Improved instrumentation to detect SGTR, or additional systems to scrub fission product releases.	1.7%	10.9%	$132k	>2 x benefit	Screen out	Screening case SGI determined the maximum benefit to be $132k. The installation would involve the installation of numerous control circuits within the racks. The N-16 system could be used to generate the high radiation signal. Close signals would be sent to the affected SG PORV, MSTV and Bypass valve, SG Blowdown Trip Valves and to the Terry Turbine steam supply valves (currently a manual valve but the valve would be changed to an AOV or MOV). Auto close to the auxiliary feedwater pumps would not be included to allow the operator time to assure that the SG had at least an 11% level before securing AFW. The mod would include the changeout of the Terry Turbine steam supply valves with control circuits to the racks and control room, instrumentation feeds from N-16 to the racks, appropriate annunciation in the control room to indicate the automatic action (including an automatic reactor trip) and wiring mods in the racks to the aforementioned components. Total cost would be $1.5-3M. Not cost beneficial; cost is estimated to exceed twice the benefit.

Table 4-6 (Cont'd)

Summary of North Anna Power Station SAMAs Considered in Benefit/Cost Analysis[a]

SAMA No.	Potential Improvement	Discussion	Reduction In CDF (bounding)	Reduction In Person-Rem Offsite (bounding)	Benefit (bounding)	Estimated Cost	Conclusion	Cost Estimate and Basis for Conclusion
86	Increase secondary side pressure capacity such that a SGTR would not cause the relief valves to lift	SGTR sequences would not have a direct release pathway.	11.9%	77.6%	$937k	>2 x benefit	Screen out	Screening case SGR shows a maximum possible benefit of removing all SGTR to be $937k. It is judged that this SAMA would likely have a cost an order of magnitude larger than this possible benefit. Not cost beneficial; cost is estimated to exceed twice the benefit.
87	Replace steam generators with new design	Lower frequency of SGTR.	11.9%	77.6%	$935k	>2 x benefit	Screen out	Screening case SGR shows a maximum possible benefit of removing all SGTR to be $935k. It is judged that this SAMA would likely have a cost an order of magnitude larger than this possible benefit. Not cost beneficial; cost is estimated to exceed twice the benefit.
99	Ensure all ISLOCA releases are scrubbed	Would scrub ISLOCA releases. One suggestion was to plug drains in the break area so the break point would cover with water.	0.00%	3.5%	$38k	>2 x benefit	Screen out	Analysis case ISS shows a maximum possible benefit of this SAMA to be $38k. Assuming the break of concern is in the Safeguards building, a firewater line would be added to flood this area. The line would be remotely operated from the control room. The line would run from the main firewater header to a discharge point in the Safeguards building. The cost is estimated at $125k. Not cost beneficial; cost is estimated to exceed twice the benefit.

Table 4-6 (Cont'd)
Summary of North Anna Power Station SAMAs Considered in Benefit/Cost Analysis[a]

SAMA No.	Potential Improvement	Discussion	Reduction In CDF (bounding)	Reduction In Person-Rem Offsite (bounding)	Benefit (bounding)	Estimated Cost	Conclusion	Cost Estimate and Basis for Conclusion
101	Add a check valve downstream of the LHSI pumps on the cold leg injection line	The ISLOCA frequency is dominated by the LHSI injection lines to the cold legs, which have 2 check valves each. Adding another check valve in the common injection line would essentially eliminate the frequency of the ISLOCA sequence through these pathways.	4.6%	18.7%	$220k	>2 x benefit	Screen out	Analysis case ISL shows a maximum possible benefit of removing all ISLOCA to be $220k. 3 check valves per unit can be added inside containment. There is an enduring cost associated with testing these check valves. Current testing is critical path, expensive and dose-intensive. Present value cost of installing the mods and performing the future testing is $750K-1.25M. Not cost beneficial; cost is estimated to exceed twice the benefit.
106	Digital feedwater upgrade	Reduces chance of loss of MFW following a plant trip.	4.5%	0.6%	$76k	>2 x benefit	Screen out	Screening case DFW determined the maximum benefit to be $76k. This modification was installed at Surry using the Bailey Net 90 hardware. Present value of the modification assuming a similar installation for North Anna would be $4-7M. Not cost beneficial; cost is estimated to exceed twice the benefit.
113	Provide portable generators to be hooked in to the turbine driven AFW, after battery depletion	Extend AFW availability in a SBO (assuming the turbine-driven AFW requires DC power).	2.0%	0.1%	$29k	>2 x benefit	Screen out	Analysis case BCH calculated the maximum benefit if batteries never drain to be $29k. Not cost beneficial; cost is estimated to exceed twice the benefit.

Table 4-6 (Cont'd)
Summary of North Anna Power Station SAMAs Considered in Benefit/Cost Analysis[a]

SAMA No.	Potential Improvement	Discussion	Reduction In CDF (bounding)	Reduction In Person-Rem Offsite (bounding)	Benefit (bounding)	Estimated Cost	Conclusion	Cost Estimate and Basis for Conclusion
120	Create passive secondary side coolers	Provide a passive heat removal loop with a condenser and heat sink. Would reduce CDF from the loss of feedwater.	16.8%	2.5%	$294k	>2 x benefit	Screen out	Screening case FDW shows the maximum possible benefit as $294k. It is judged that this SAMA would likely be an order of magnitude greater than this benefit. Not cost beneficial; cost is estimated to exceed twice the benefit.
121	Automate air bottle swap for S/G PORVs	Manual action is required to swap air source to the air bottles. Automatic swap on low pressure would eliminate the operator action.	0.00%	0.00%	$0	>2 x benefit	Screen out	Analysis case SGP showed no benefit to 3 significant digits. Not cost beneficial; cost is estimated to exceed twice the benefit.
122	Condenser dump after SI	Utilize bypass around the main steam trip valves to use the condenser dump after an SI (the PRA assumes the function can not be recovered after an SI signal).	0.3%	0.00%	$5k	>2 x benefit	Screen out	Analysis case CND shows the maximum possible benefit to be $5k. Not cost beneficial; cost is estimated to exceed twice the benefit.
123	Provide capability for diesel driven, low-pressure vessel makeup	Extra water source in sequences in which the reactor is depressurized and all other injection is unavailable (e.g., firewater).	5.6%	0.00%	$82k	>2 x benefit	Screen out	Analysis case LHI shows the benefit to be $82k. The total cost would include adding a line from the firewater header, a post indicator valve in the yard and SR double isolation valves to the connection with the LHSI system. Total cost would be $350-600K. Not cost beneficial; cost is estimated to exceed twice the benefit.

Table 4-6 (Cont'd)
Summary of North Anna Power Station SAMAs Considered in Benefit/Cost Analysis[a]

SAMA No.	Potential Improvement	Discussion	Reduction In CDF (bounding)	Reduction In Person-Rem Offsite (bounding)	Benefit (bounding)	Estimated Cost	Conclusion	Cost Estimate and Basis for Conclusion
124/ 125	Provide an additional high pressure injection pump with independent diesel	Reduce frequency of core melt from small LOCA sequences, and from SBO sequences.	0.03%	0.00%	<$1k	>2 x benefit	Screen out	Analysis case HPI shows the maximum possible benefit to be less than $1k. Not cost beneficial; cost is estimated to exceed twice the benefit.
143/ 144	Install MG set trip breakers in control room	Provides trip breakers for the motor generator sets in the control room. Currently, at Watts Bar, an ATWS would require an immediate action outside the control room to trip the MG sets. Would reduce ATWS CDF.	1.3%	0.1%	$20k	>2 x benefit	Screen out	Screening case ATW shows the maximum possible benefit to be $20k. Not cost beneficial; cost is estimated to exceed twice the benefit.

Table 4-6 (Cont'd)
Summary of North Anna Power Station SAMAs Considered in Benefit/Cost Analysis[a]

SAMA No.	Potential Improvement	Discussion	Reduction In CDF (bounding)	Reduction In Person-Rem Offsite (bounding)	Benefit (bounding)	Estimated Cost	Conclusion	Cost Estimate and Basis for Conclusion
152/ 153	Create/ enhance reactor coolant system depressuriza-tion ability	Either with a new depressurization system, or with existing PORVs, head vents and secondary side valve, RCS depressurization would allow low-pressure ECCS injection. Even if core damage occurs, low RCS pressure alleviates some concerns about high pressure melt ejection.	0.00%	0.00%	$0	>2 x benefit	Screen out	The NAPS Level 2 analysis shows that high pressure melt ejection is not a threat to containment failure. NAPS procedures already direct depressurization in the appropriate Level 1 sequences. Analysis case DEB shows that there is no benefit in the level 2 analysis for low pressure injection after core damage. Therefore, revision to existing procedures or creation of a new system would not be estimated to provide any benefit.
156	Secondary side guard pipes up to the MSIVs	Would prevent secondary side depressurization should a steam line break occur upstream of the MSIVs. Would also guard against or prevent consequential multiple SGTR following a main steam line break event.	0.00%	0.00%	$0	>2 x benefit	Screen out	The NAPS PRA presents that MSLBs are an insignificant risk at NAPS. Therefore, this SAMA has an insignificant benefit and is screened out. Not cost beneficial; cost is estimated to exceed twice the benefit.

Table 4-6 (Cont'd)
Summary of North Anna Power Station SAMAs Considered in Benefit/Cost Analysis[a]

SAMA No.	Potential Improvement	Discussion	Reduction In CDF (bounding)	Reduction In Person-Rem Offsite (bounding)	Benefit (bounding)	Estimated Cost	Conclusion	Cost Estimate and Basis for Conclusion
157	Digital large break LOCA protection	Upgrade plant instrumentation and logic to improve the capability to identify symptoms/precursors of a large break LOCA (a leak before break).	2.9%	0.01%	$22k	>2 x benefit	Screen out	Analysis case LLO shows a benefit of $21k for this SAMA, which assumed a reduction in large LOCA frequency of 25%. It is judged that the cost of such instrumentation would be many times greater than $22k to be able to achieve this benefit. Not cost beneficial; cost is estimated to exceed twice the benefit.

a. Source: Appendix G, Table G.2-2.

4.21 References

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Ref. 4.17-1 Bradshaw, P. 2000. "Land use planning information for Louisa County". Personal communication with Y. F. Abernethy (TtNUS). March 17.

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Ref. 4.20-3 U.S. Nuclear Regulatory Commission. 1995. "Reassessment of NRC's Dollar Per Person-Rem Conversion Factor Policy." NUREG-1530.

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5.0 ASSESSMENT OF NEW AND SIGNIFICANT INFORMATION

5.1 Discussion

NRC Input

"...The environmental report must contain any new and significant information regarding the environmental impacts of the license renewal of which the applicant is aware." 10 CFR 51.53(c)(3)(iv)

The U.S. Nuclear Regulatory Commission (NRC) licenses the operation of domestic nuclear power plants and provides for license renewal, requiring a license renewal application that includes an environmental report (10 CFR 54.23). NRC regulations, 10 CFR 51, prescribe the environmental report content and identify the specific analyses the applicant must perform. In an effort to make the environmental review focussed and efficient, NRC has resolved most of the environmental issues generically and only requires an applicant's analysis of the remaining issues.

While NRC regulations do not require an applicant's environmental report to contain analyses of the impacts of those environmental issues that have been generically resolved (termed "Category 1") [10 CFR 51.53(c)(3)(i)], the regulations do require that an applicant identify any new and significant information of which the applicant is aware [10 CFR 51.53(c)(3)(iv)]. The purpose of this requirement is to alert the NRC staff to such information, so the staff can determine whether to seek the Commission's approval to waive or suspend application of the rule with respect to the affected generic analysis. NRC has explicitly indicated, however, that an applicant is not required to perform a site-specific validation of conclusions NRC made for Category 1 issues in the *Generic Environmental Impact Statement for License Renewal of Nuclear Plants* (GEIS) (Ref. 5.1-1, page C9-13, Concern Number NEP.015) because the NRC has concluded that, in all cases, the impacts would be small.

Dominion expects that new and significant information would include:

- Information that identifies a significant environmental issue not covered in the GEIS and codified in the regulation, or
- Information that was not covered in the GEIS analyses and that leads to an impact finding different from that codified in the regulation.

NRC requires license renewal applicants to provide NRC with input, in the form of an environmental report, that NRC will use to meet National Environmental Policy Act (NEPA) requirements as they apply to license renewal (10 CFR 51.10). NEPA authorizes the Council on Environmental Quality (CEQ) to establish implementing regulations for federal agency use. CEQ guidance provides that federal agencies should prepare environmental impact

statements for actions that would significantly affect the environment (40 CFR 1502.3), focus on significant environmental issues (40 CFR 1502.1), and eliminate from detailed study issues that are not significant [40 CFR 1501.7(a)(3)]. The CEQ guidance includes a lengthy definition of "significantly" that requires consideration of the context of the action and the intensity or severity of the impact(s) (40 CFR 1508.27). Although NRC does not specifically define the term "significantly", Dominion used the guidance available in CEQ regulations to establish significance. Based on this guidance and the definitions of small, moderate, and large impacts provided by NRC, Dominion expects that moderate or large impacts would be significant. Chapter 4 presents the NRC definitions of "moderate" and "large" impacts.

Dominion implemented an assessment process for new and significant information during preparation of the license renewal application for North Anna Power Station (NAPS). The process was directed by the License Renewal Project Environmental Lead and included the following actions: (1) interviews with Dominion subject experts on information related to the conclusion in the GEIS as the relate to NAPS, (2) review of documents related to environmental issues at NAPS, (3) consultations with state and federal agencies to determine if the agencies had concerns not addressed in the GEIS, (4) a review of internal procedures for reporting to the NRC events that could have environmental impacts, and (5) credit for the oversight provided by inspections of plant facilities by state and federal regulatory agencies. As a result of this assessment, Dominion is aware of no new and significant information regarding the environmental impacts of NAPS Units 1 and 2 license renewal.

5.2 References

Ref. 5.1-1 U.S. Nuclear Regulatory Commission. 1996. *Public Comments on the Proposed 10 CFR Part 51 Rule for Renewal of Nuclear Power Plant Operating Licenses and Supporting Documents: Review of Concerns and NRC Staff Response.* Volumes 1 and 2. NUREG-1529. Washington, DC.

6.0 SUMMARY OF LICENSE RENEWAL IMPACTS AND MITIGATING ACTIONS

6.1 License Renewal Impacts

Dominion has reviewed the environmental impacts of renewing North Anna Power Stations Units 1 and 2 (NAPS) operating licenses and has concluded that all of the impacts would be small and would not require mitigation. This environmental report documents the basis for Dominion's conclusion. Chapter 4 incorporates by reference U.S. Nuclear Regulatory Commission (NRC) findings for the 50 Category 1 issues that apply to NAPS (Table 4-2). The rest of Chapter 4 analyzes Category 2 issues, all of which are either not applicable or have impacts that would be small. Table 6-1 identifies the impacts that NAPS license renewal would have on resources associated with Category 2 issues.

6.2 Mitigation

NRC Input

"The report must contain a consideration of alternatives for reducing adverse impacts...for all Category 2 license renewal issues...." 10 CFR 51.53(c)(3)(iii)

"The environmental report shall include an analysis that considers and balances...alternatives available for reducing or avoiding adverse environmental effects...." 10 CFR 51.45(c) as incorporated by 10 CFR 51.53(c)(2)

All impacts of license renewal are small and would not require mitigation. Current operations include mitigation activities that would continue during the term of the license renewal. Dominion performs routine mitigation and monitoring activities associated with environmental permits to ensure the safety of workers, the public, and the environment. These activities include the radiological environmental monitoring program, continuous emission monitoring, monitoring of aquatic biota that could be affected by NAPS operation, effluent chemistry monitoring, and effluent toxicity testing.

6.3 Unavoidable Adverse Impacts

NRC Input

The environmental report shall discuss any "...adverse environmental effects which cannot be avoided should the proposal be implemented..." 10 CFR 51.45(b)(2) as adopted by 10 CFR 51.53(c)(2)

This environmental report adopts by reference NRC findings for applicable Category 1 issues, including discussions of any unavoidable adverse impacts (Table 4-2). Dominion evaluated 21 Category 2 issues, analyzed impacts from 16 Category 2 issues that apply to NAPS, and identified the following unavoidable adverse impacts of license renewal:

- Some fish are impinged on the NAPS intake traveling screens. The fish species most commonly impinged during the 1978-1983 Clean Water Act (CWA) Section 316(b) studies was gizzard shad (61 percent of all fish impinged), a common forage fish with a high reproductive potential (Ref. 6.3-1, page 51). Four common game fish (black crappie, yellow perch, bluegill, and white perch) comprised 37 percent of fish impinged. Based on the Section 316(b) study and subsequent monitoring, impingement has not had a discernible effect on Lake Anna's fish populations.
- Some larval fish are entrained at the NAPS intake. Gizzard shad made up approximately 66 percent of all fish entrained over the 1978-1983 period (Ref. 6.3-1, Table 6-1). Most of

NRC Input

[picture not included] North Anna Power Station intake

the other fish entrained came from three groups: white perch (15 percent), sunfish (13 percent), and yellow perch (5 percent). The Section 316(b) study concluded that entrainment rates were relatively low at NAPS and that entrainment had minimal impact on Lake Anna's fish populations.

For purposes of analysis, Dominion assumed that license renewal would require 60 additional staff, although Dominion does not expect to need that many additional staff. The addition of 283 households to the four counties in which the majority of the current NAPS workers reside would result in impacts to housing availability, transportation infrastructure, and public utilities that may not be considered adverse, but are not significant.

6.4 Irreversible and Irretrievable Resource Commitments

NRC Input

The environmental report shall discuss any "...irreversible and irretrievable commitments of resources which would be involved in the proposed action should it be implemented " 10 CFR 51.45(b)(5) as adopted by 10 CFR 51.53(c)(2)

The continued operation of NAPS for the license renewal term would result in irreversible and irretrievable resource commitments, including the following:

- nuclear fuel, which is burned in the reactors and converted to radioactive waste
- the land required to dispose of spent nuclear fuel, low-level radioactive wastes generated as a result of plant operations, and sanitary wastes generated from normal industrial operations
- elemental materials that would become radioactive
- materials used for the normal industrial operations of the plant that cannot be recovered or recycled or that are consumed or reduced to unrecoverable forms.

6.5 Short-Term Use Versus Long-Term Productivity of the Environment

NRC Input

The environmental report shall discuss the "...relationship between local short-term uses of man's environment and the maintenance and enhancement of long-term productivity..." 10 CFR 51.45(b)(4) as adopted by 10 CFR 51.53(c)(2)

The current balance between short-term use and long-term productivity at NAPS was established once the Units began operating in the 1970s. The North Anna Power Station Final Environmental Statement (Ref. 6.5-1) evaluated the impacts of constructing and operating NAPS in rural north-central Virginia. Some 18,600 acres were acquired from private land owners for the development of the NAPS site, a cooling water source (Lake Anna), the Waste Heat Treatment Facility (WHTF), and associated transmission line rights-of-way. Most (80 percent) of this land was forested, with the remaining land used for small dairy and cattle farms. The bulk of the land was used in the creation of Lake Anna (9,600 acres) and the WHTF (3,400 acres). The approximately 6,600 acres that were not inundated could be returned to agricultural uses (e.g., tree farming, dairy farming, beef-cattle farming) after NAPS is decommissioned, but decisions on the ultimate disposition of these lands have not been made. Continued operations for an additional 20 years would not alter this conclusion.

TABLES

Table 6-1
Environmental Impacts Related to License Renewal at
North Anna Power Station Units 1 and 2

No.	Issue	Environmental Impact
	Surface Water Quality, Hydrology, and Use (for all plants)	
13	Water use conflicts (plants with cooling ponds or cooling towers using make-up water from a small river with low flow)	None. This issue does not apply because NAPS does not use cooling ponds or cooling towers.
	Aquatic Ecology (for plants with once-through and cooling pond heat dissipation systems)	
25	Entrainment of fish and shellfish in early life stages	Small. Dominion has a current VPDES permit which constitutes compliance with CWA Section 316(b) requirements to provide best available technology to minimize entrainment.
26	Impingement of fish and shellfish	Small. Dominion has a current VPDES permit which constitutes compliance with CWA Section 316(b) requirements to provide best available technology to minimize impingement.
27	Heat shock	Small. Dominion has a current VPDES permit that states that effluent thermal limitations more stringent than those in the permit are not required to assure a balanced and indigenous biological community in Lake Anna and the North Anna River downstream of the lake.
	Groundwater Use and Quality	
33	Groundwater use conflicts (potable and service water, and dewatering; plants that use > 100 gpm)	None. This issue does not apply because NAPS uses less than 100 gpm.
34	Groundwater use conflicts (plants using cooling towers withdrawing makeup water from a small river)	None. This issue does not apply because NAPS does not use cooling towers.
35	Groundwater use conflicts (Ranney wells)	None. This issue does not apply because NAPS does not use Ranney wells.

Table 6-1 (Cont'd)
Environmental Impacts Related to License Renewal at
North Anna Power Station Units 1 and 2

No.	Issue	Environmental Impact
39	Groundwater quality degradation (cooling ponds at inland sites)	None. This issue does not apply because NAPS does not use cooling ponds.
	Terrestrial Resources	
40	Refurbishment impacts	No impacts are expected because NAPS will not undertake refurbishment.
	Threatened or Endangered Species	
49	Threatened or endangered species	Small. Although bald eagles forage along rivers and large lakes, Dominion is not aware of any eagle nests at NAPS or along the transmission lines. Other threatened and endangered aquatic species might be present in water bodies crossed by NAPS transmission line corridors, but there is no indication that any such species would be affected by continued operation of NAPS.
	Air Quality	
50	Air quality during refurbishment (nonattainment and maintenance areas)	No impacts are expected because NAPS will not undertake refurbishment.
	Human Health	
57	Microbiological organisms (public health) (plants using lakes or canals, or cooling towers or cooling ponds that discharge to a small river)	Small. State and federal officials have determined that the risk of contracting primary amoebic meningoencephalitis from *Naegleria* in the WHTF and Lake Anna was too low to justify any action by Dominion or state agencies, based on water temperatures below optimum for growth, wastewater disinfection practices, low naturally-occurring populations, and Virginia State Epidemiologist review.

Table 6-1 (Cont'd)
Environmental Impacts Related to License Renewal at
North Anna Power Station Units 1 and 2

No.	Issue	Environmental Impact
59	Electromagnetic fields, acute effects (electric shock)	Small. Analysis determined that none of the four NAPS transmission lines has the capacity to induce as much as 5 milliamperes in a vehicle parked beneath the lines. Therefore, all NAPS transmission line designs conform to the NESC® provisions for preventing electric shock from induced current.
	Socioeconomics	
63	Housing impacts	Small. NAPS is in a medium-population area. Dominion has concluded that housing impacts would be small from 60 new employees.
65	Public services: public utilities	Small. Any increases in public water demand from 60 new employee households would be an insignificant percentage of the water supplies of the affected communities and Dominion concludes that impacts would be small.
66	Public services: education (refurbishment)	No impacts are expected because NAPS will not undertake refurbishment.
68	Offsite land use (refurbishment)	No impacts are expected because NAPS will not undertake refurbishment.

Table 6-1 (Cont'd)
Environmental Impacts Related to License Renewal at
North Anna Power Station Units 1 and 2

No.	Issue	Environmental Impact
69	Offsite land use (license renewal term)	Small. NAPS is the dominant source of tax revenue for Louisa County, but provides less than one percent of tax revenue for Orange and Spotsylvania Counties. Since construction of the plant, surrounding counties have not experienced large land-use changes, even though residential growth associated with Lake Anna has increased. License renewal would have a continued positive effect on the surrounding counties, but would not induce changes to local land use or development.
70	Public services: transportation	Small. Any additional employees would be fewer than the temporary outage workforce of 700 additional people. Access roads are adequate for the increase in traffic resulting from outages. Therefore, Dominion concludes that there would be no transportation impacts.
71	Historic and archaeological resources	Small. Continued operation of NAPS does not require construction at the site or new transmission lines. Therefore, Dominion concludes that it would not adversely affect historic or archaeological resources.

Table 6-1 (Cont'd)
Environmental Impacts Related to License Renewal at
North Anna Power Station Units 1 and 2

No.	Issue	Environmental Impact
	Postulated Accidents	
76	Severe accidents	Small. The benefit/cost analysis identified no severe accident mitigation alternatives that would avert public risk.[a]

a. NRC determined that risk of severe accidents is small for all plants (10 CFR 51, Subpart A, Appendix B, Table B-1, Issue 76) but that alternatives to mitigate severe accidents must be considered for plants that have not considered such alternatives.

6.6 References

Ref. 6.3-1 Virginia Power Company. 1985. *Impingement and Entrainment Studies for Nor th Anna Power Station 1978 - 1983*. Prepared by Water Quality Department. Richmond, VA.

Ref. 6.5-1 U.S. Atomic Energy Commission. 1973. *Final Environmental Statement related to the continuation of construction and the operation of Units 1 & 2 and the construction of Units 3 & 4 -- North Anna Power Station*. Docket Nos. 50-338 and 50-339/Docket Nos. 50-404 and 50-405. Virginia Electric and Power Company.

7.0 ALTERNATIVES TO THE PROPOSED ACTION

NRC Input

The environmental report shall discuss "Alternatives to the proposed action...." 10 CFR 51.45(b)(3), as adopted by reference at 10 CFR 51.53(c)(2).

"...The report is not required to include discussion of need for power or economic costs and benefits of ... alternatives to the proposed action except insofar as such costs and benefits are either essential for a determination regarding the inclusion of an alternative in the range of alternatives considered or relevant to mitigation...." 10 CFR 51.53(c)(2).

"While many methods are available for generating electricity, and a huge number of combinations or mixes can be assimilated to meet a defined generating requirement, such expansive consideration would be too unwieldy to perform given the purposes of this analysis. Therefore, NRC has determined that a reasonable set of alternatives should be limited to analysis of single, discrete electric generation sources and only electric generation sources that are technically feasible and commercially viable..." (Ref. 7.0-1, Section 8.1).

"...The consideration of alternative energy sources in individual license renewal reviews will consider those alternatives that are reasonable for the region, including power purchases from outside the applicant's service area...." (Ref. 7.0-2, Section II.H, pg. 66541, column 3).

Chapter 7 evaluates alternatives to North Anna Power Station Units 1 and 2 (NAPS) license renewal. The chapter identifies actions that could be necessary to meet system generating needs now provided by NAPS and associated environmental impacts, if the U.S. Nuclear Regulatory Commission (NRC) did not renew the plant operating licenses. The chapter also identifies alternative actions that Dominion has evaluated, but determined to be unreasonable, and presents the information upon which Dominion based that decision.

Dominion divided its alternatives discussion into two categories, "no action" and "alternatives that meet system generating needs". In considering the level of detail and analysis necessary for each category, Dominion relied on the NRC decision-making standard for license renewal:

"…the NRC staff, adjudicatory officers, and Commission shall determine whether or not the adverse environmental impacts of license renewal are so great that preserving the option of license renewal for energy planning decision makers would be unreasonable." [10 CFR 51.95(c)(4)].

Dominion determined that as long as the environmental report provides sufficient information to clearly indicate whether an alternative would have a smaller, comparable, or greater environmental impact than the proposed action, the document would support NRC decision making. Providing additional detail or analysis would serve no function if it would only bring to light more adverse impacts of alternatives to license renewal. This approach is consistent with regulations of the Council on Environmental Quality, which specify that the consideration of alternatives (including the

proposed action) should enable reviewers to evaluate their comparative merits (40 CFR 1500-1508). Dominion believes that Chapter 7 provides sufficient detail about alternatives to establish the basis for necessary comparisons to the Chapter 4 discussion of impacts from the proposed action.

In characterizing environmental impacts from alternatives, Dominion has used the same definitions of "small", "moderate", and "large" that the Chapter 4 Introduction presents.

7.1 No-Action Alternative

Dominion is using the "no-action" alternative to refer to a scenario in which the NRC does not renew the NAPS operating licenses. Components of this alternative include replacing the generating capacity of NAPS and decommissioning the facility, as described below.

Presently, NAPS annually provides approximately 14 terawatts hours of electricity (a terawatt hour is one billion kilowatt hours). This is more than 20 percent of the power that Dominion provides to its more than 2 million home and business customers (Ref. 7.1-1). Dominion believes that any alternative would be unreasonable if it did not include replacing this capacity. Replacement could be accomplished by (1) building new generating capacity, (2) purchasing power from outside the Dominion system, or (3) reducing power requirements through demand reduction. Section 7.2.1 describes each of these possibilities in detail, and Section 7.2.2 describes environmental impacts from feasible alternatives.

The *Generic Environmental Impact Statement for License Renewal of Nuclear Plants* (GEIS, Ref. 7.0-1, pg. 7-1) defines decommissioning as the safe removal of a nuclear facility from service and the reduction of residual radioactivity to a level that permits release of the proper ty for unrestr icted use and termination of the license. NRC-evaluated decommissioning options include immediate decontamination and dismantlement (DECON), and safe storage of the stabilized and defueled facility (SAFSTOR) for a period of time, followed by decontamination and dismantlement. Regardless of the option chosen, decommissioning must be completed within a 60-year period. Under the no-action alternative, Dominion would continue operating NAPS until the current licenses expired, then initiate decommissioning activities in accordance with NRC requirements. The GEIS describes decommissioning activities based on an evaluation of an example reactor (the "reference" pressurized-water reactor is the 1,175-megawatt [MW] Trojan Nuclear Plant reactor). This description is comparable to decommissioning activities that Dominion would conduct at NAPS, but Dominion notes that the reference unit size is larger than the NAPS unit size (982 MW).

As the GEIS notes, NRC has evaluated environmental impacts from decommissioning. NRC-evaluated impacts include: occupational and public dose; impacts of waste management; impacts to air and water quality; and ecological, economic, and socioeconomic impacts. NRC indicated (Ref. 7.1-2, pg. 4-15) that the environmental effects of greatest concern (i.e., radiation dose and releases to the environment) are substantially less than the same effects resulting from reactor operations. Dominion adopts by reference the NRC conclusions regarding environmental impacts of decommissioning.

Dominion notes that decommissioning activities and their impacts are not discriminators between the proposed action and the no-action alternative. Dominion will have to

decommission NAPS regardless of the NRC decision on license renewal; license renewal would only postpone decommissioning for an additional 20 years. The NRC has established in the GEIS that the timing of decommissioning operations does not substantially influence the environmental impacts of decommissioning. Dominion adopts by reference the NRC findings (10 CFR 51 Appendix B, Table B-1, Decommissioning) to the effect that delaying decommissioning until after the renewal term would have small environmental impacts. The discriminators between the proposed action and the no-action alternative lie within the choice of generation replacement options to be part of the no-action alternative. Section 7.2.2 analyzes the impacts from these options.

Dominion concludes that the decommissioning impacts under the no-action alternative would not be substantially different from those occurring following license renewal as identified in the GEIS (Ref. 7.0-1) and the decommissioning generic environmental impact statement (Ref. 7.1-2). These impacts would be temporary and would occur at the same time as the impacts from meeting system generating needs.

7.2 Alternatives That Meet System Generating Needs

Decisions regarding reasonable alternatives for meeting electrical demands in Virginia are made primarily by two entities, utilities and the Virginia State Corporation Commission. The current mix of power generation options in Virginia is one indicator of what these entities believe are feasible alternatives within the Commonwealth. In 1996, Virginia's electric utility industry had a total generating capability of 14.8 gigawatts-electric (a gigawatt is one million kilowatts). This capability includes units fueled by coal (34 percent); nuclear (23 percent); oil (15 percent); gas (7 percent); and hydroelectric (21 percent) (Ref. 7.2-1, Figure 1).

Approximately 3.6 gigawatts electric (20 percent of the Commonwealth's generating capability) was from nonutility sources (Ref. 7.2-1, Table 4). Nonutility generators also use a variety of energy sources.

Based on 1996 generation data, utility companies provided 56.5 terawatt hours of electricity. Utilities' generation was dominated by coal (49 percent), followed by nuclear (47 percent), gas (2 percent), oil (1 percent), and other (1 percent) (Ref. 7.2-1, Figure 2). Approximately 10.5 terawatt hours of electricity (16 percent of the Commonwealth's generation) was provided by nonutility sources (Ref. 7.2-1, Table 5).

The difference between capability and utilization reflects preferential usage. For example, nuclear energy represented 23 percent of utilities' installed capability, but produced 47 percent of the electricity generated by utilities (Ref. 7.2-1, Figures 1 and 2, respectively). This reflects Virginia's preferential reliance on nuclear energy as a base-load generating source. Figures 7-1 and 7-2 illustrate Virginia's utility generating capabilities and utilization, respectively.

Figure 7-3 illustrates the Dominion energy capability mix in 1998, which differs from the total Commonwealth's utility industry (Ref. 7.2-1, Figure 7-1). In 1998, 33 percent of Dominion's capability was from nuclear, 42 percent was from coal; oil and other sources each provided 3 percent. Dominion relied on power purchased from utility and nonutility generators for 19 percent of its energy capability mix in 1998. As of January 1, 1999, Dominion's summer net capacity was 13.6 gigawatts with a nuclear capacity of 3.4 gigawatts, a fossil capacity of 8.7 gigawatts, and a hydroelectric capacity of 1.6 gigawatts. In addition, nonutility generation provided 3.3 gigawatts and purchases from other utilities totaled 1.2 gigawatts, for a combined total summer capacity of 18.2 gigawatts (Ref. 7.2-2, pg. 1).

7.2.1 Alternatives Considered

Technology Choices

Dominion routinely conducts evaluations of alternative generating technologies. The most recent generation expansion options planning study reviews emerging technologies, opportunity fuels, and technology development programs (Ref. 7.2-3). Technologies included advanced fossil conversion, advanced energy systems, renewables, waste fuel systems, and energy storage. The U.S. Rural Electrification Administration (REA) recently evaluated alternatives to Dominion-proposed generation capacity construction (Ref. 7.2-4).

The REA evaluation covered the following topics:

- alternatives not requiring new construction (no action, purchase power, and conservation and load modifications)
- alternatives requiring new generation (joint venture, generation, and cogeneration and independent power production)
- alternative generation technologies (combustion turbines, combined cycle, hydroelectric, nuclear, refuse/biomass, and others)
- alternative plant sites
- alternative plant systems.

Based on these and other internal evaluations, Dominion has concluded that feasible new plant systems for Dominion planning purposes are limited to pulverized coal for base-load operation, advanced combustion turbines for peak-load operations, and advanced combined-cycle units for mid-load operations. These conclusions are borne out by the generation utilization information that Section 7.2 introductory text describes: coal and gas are the most heavily utilized non-nuclear generating technologies in Virginia. For purposes of the NAPS license renewal environmental report, Dominion has limited its alternatives analysis for new generating capacity to the technologies it considers feasible: pulverized coal- and gas-fired units. For purposes of the NAPS license renewal environmental report,

Dominion has limited its alternatives analysis for new generating capacity to the technologies it considers feasible to replace the large base-load NAPS units: pulverized coal-fired units and gas-fired combined-cycle turbines.

Mixture

The NRC indicated in the GEIS that, while many methods are available for generating electricity and a huge number of combinations or mixes can be assimilated to meet system needs, such expansive consideration would be too unwieldy given the purposes of the alternatives analysis. Therefore, NRC determined that a reasonable set of alternatives should be limited to analysis of single, discrete electric generation sources and only electric

generation technologies that are technically reasonable and commercially viable (Ref. 7.0-1, pg. 8-1). Consistent with the NRC determination, Dominion has not evaluated mixes of generating sources.

Deregulation

Beginning in 1996, the Commonwealth of Virginia began restructuring the electric utility industry in the state. It is expected to be fully deregulated by 2007. A deregulated market is perceived as having benefits in areas of economic efficiency, allocation of resources, and customer choices. Advances in technology are producing lower-cost, more flexible power generation options (Ref. 7.2-5, paragraphs 4 and 5). For example, Dominion has implemented Project Current Choice, a program under which customers could begin selecting an alternative provider (Ref. 7.2-6).

Nonutility generation has arisen as a principal source of new generating capacity in Virginia, which is the first major source of competition for construction and operation of power plants. The Virginia State Corporation Commission has been generally supportive of a balance between utility construction and purchase from nonutility generators. However, it was reluctant to grant Dominion the authority in 1999 to construct four gas-fired turbine generators that would provide up to 600 MW of power by July 1, 2000. The 1999 Virginia General Assembly enacted the Electric Utility Restructuring Act, which opens the generation market and foresees competition as the primary regulator of the price of electricity. For the law to work as intended, there must be many generators or other suppliers to provide for the needs of customers and these must be willing to compete for business on the basis of price, service, and other factors. The State Corporation Commission "will take all necessary actions to mitigate market power, to ensure that the operation of generating units of incumbent utilities will not inhibit the development of competition within the Commonwealth, ..." (Ref. 7.2-7).

The interrelationship of economic deregulation of generation and nuclear power is of particular concern. The State Corporation Commission feels that maintenance of the nuclear industry in Virginia is critical from reliability, fuel diversity, and public health and safety perspectives (Ref. 7.2-8, pg. 4).

Based on the issues detailed above, it is not clear that Dominion would be granted the authority to construct new generating units to replace NAPS if its licenses were not renewed. However, regardless of what entities constructed and operated the replacement power sources, certain environmental parameters would be constant among replacement power sources. Therefore, it is appropriate and instructive for Dominion to discuss the impacts of reasonable alternatives to the NAPS.

Alternatives

The following sections present new systems for fossil-fuel-fired generation (Section 7.2.1.1) and imported power (Section 7.2.1.2) as reasonable alternatives to license renewal. Section 7.2.1.3 discusses reduced demand and presents the basis for concluding that it is not a reasonable alternative to license renewal.

7.2.1.1 Construct and Operate Fossil-Fuel-Fired Generation

Dominion analyzed hypothetical new coal- and gas-fired units at the existing NAPS site. This approach could minimize environmental impacts by building on previously disturbed land and by making the most possible use of existing facilities: transmission lines, roads and parking areas, office buildings, and the cooling system.

For comparability, Dominion selected coal- and gas-fired units of equal electric power and equal capacity factors. A scenario of, for example, two 895-MW units could be assumed to replace the 1,790-MW NAPS net capacity. However, Dominion's experience indicates that, although customized unit sizes can be built, using standardized sizes is more economical. For example, a manufacturer's standard-sized units include a gas-fired combined-cycle unit of 508 MWe net (GE Frame 7FA) capacity. Dominion evaluated constructing three 508-MW gas-fired units (Table 7-2) and, for comparability, set the net power of the coal-fired units at 508 MW (Table 7-1). Although this provides less capacity than the existing units, it ensures against overestimating environmental impacts from these alternatives. The shortfall in capacity could be replaced by other methods (see Mixture in Section 7.2.1).

It must be emphasized, however, that these are hypothetical scenarios. Dominion does not have plans for such construction at NAPS.

Coal-Fired Generation

NRC evaluated coal-fired generation alternatives for the Calvert Cliffs Nuclear Ref. 7.2-9, Section 8.2.1) and for the Oconee Nuclear Station (Ref. 7.2-10, Section 8.2.1). For Calvert Cliffs, NRC analyzed three 600-MW units. Dominion has reviewed the NRC analysis and believes it to be sound. In defining the NAPS coal-fired alternative, Dominion has used site- and Virginia-specific input and has scaled from the NRC analysis, where appropriate.

Table 7-1 presents the basic coal-fired alternative emission control characteristics. Dominion based its emission control technology and percent control assumptions on alternatives that the U.S. Environmental Protection Agency (EPA) has identified

as being available for minimizing emissions (Ref. 7.2-11). Coal and limestone (or lime) would be delivered via a CSXT rail line to an existing 7-mile rail spur that leads to North Anna. The rail system at the North Anna site would require modifications to handle these increased rail deliveries.

Gas-Fired Generation

Dominion's current emphasis on gas-fired generation is evidenced by its ongoing: (a) construction of 596 MW of gas-fired combustion turbine capacity to be operational in 2000; (b) application to construct two additional combustion turbines to be operational in 2001; and (c) the conversion of Possum Point units to a gas-fired facility. Dominion has chosen to evaluate gas-fired generation, using combined-cycle turbines, because it has determined that the technology is mature, economical, and feasible. Dominion experience indicates that readily available standard-sized gas-fired units of 508-MW are more economical than customized units. Therefore, Dominion has analyzed 1524-MW of net power, consisting of three 508-MW gas-fired units located on NAPS property. Table 7-2 presents the basic gas-fired alternative characteristics. Dominion realizes that gas availability would be questionable. It would require a new dedicated, high pressure 24-inch pipeline from Gordonsville, Virginia. In the winter, it may become necessary for Dominion to operate on fuel oil, which would have higher costs and more emissions than gas.

7.2.1.2 **Purchase Power**

Dominion has evaluated conventional and prospective power supply options that could be reasonably implemented in the 2000-2009 time period. Virginia Electric and Power Company filed its annual Integrated Resource Plan (IRP) with the North Carolina Commission on September 1, 1999 (Ref. 7.2-15). As outlined in the IRP, Dominion has firm purchase agreements throughout the forecast period ending in 2009. These firm purchases include a 145-MW purchase agreement with the Southeastern Power Administration and contracts for approximately 3,500 MW of non-utility generation. Dominion presumes that this capacity would be available for purchase after these contracts expire, and could be imported to the region indefinitely to meet current and future demand.

These purchases alone would not be sufficient to satisfy the projected future demand. Dominion constructed combustion turbines with a capacity of 596 MW to be operational in the summer of 2000. The Company has sought approval to construct two additional combustion turbine units to be operational in the summer of 2001. Also included in the projection is a savings of 74 MW from the net effect

of various demand side management (DSM) programs. The generation shortfall will be made up through purchases from the generation market. Projected purchases from the generation market would begin in 2001 with 318 MW and grow to 1,893 MW in 2009. To increase its capability to import power, Dominion is building a 500-kilovolt (kV) transmission line from the Joshua Falls substation near Lynchburg to the substation at Ladysmith in Caroline County. This interconnect is expected to be operational by 2001.

Contracts with Southeastern Power Administration and non-utility generators are included in discussions of Dominion's current and future capacity. Other than discussed above, no substantial new capacity or purchases are foreseen in the Dominion network. Therefore, Dominion would require a major increase in purchases (1,790 MW) from the generation market outside the Dominion network to replace NAPS. Dominion presumes that the generating technology producing purchased power would be one of those that NRC analyzed in the GEIS. For this reason, Dominion is adopting by reference, as representative of the purchased power alternative, the GEIS description of the alternative generating technologies. Of these technologies, simple-cycle combustion turbines or combined-cycle facilities fueled by natural gas are found to be the most cost-effective. There has been a corresponding decreased incentive for boilers fired by coal or residual oil.

Although purchased power could provide at least part of the replacement power for NAPS, Dominion identified drawbacks to the alternative, including the following:

- The existing power transmission infrastructure currently lacks capacity to import an additional 1,790 MW of power to replace NAPS capacity. It would require the construction of at least one additional 500-kV transmission line.
- To ensure its capability to meet customer demands for reliable and affordable power, Dominion limits the amount of power it imports. Under its current power-import restriction, it is unlikely that Dominion could both implement its current plans to increase purchases from the generation market and replace the power generated by NAPS with imported power.
- Utility generators providing power to Dominion would need to increase their capacity with new power units. As described above, the most cost-effective alternatives for increasing electric power capacity are simple-cycle combustion turbines or combined-cycle facilities fueled primarily by natural gas. However existing gas line capacity in Virginia is inadequate to support more gas-fired

combustion turbines. Constructing additional pipeline capacity is both time-consuming and expensive.

- Deregulation is expected to be in place by 2007. Under deregulation, non-utility generators could compete directly with utility companies for the generation market. This is expected to decrease non-utility generators' incentive to provide wholesale power to utility companies.

7.2.1.3 **Reduce Demand**

Dominion offers the following four DSM programs, which either conserve energy or allow the Company to reduce customers' load requirements during periods of peak demand. The four programs are:

Conservation Program

- Energy Saver Home Plus (in North Carolina only)

Load Management Programs

- Rate Schedule SG -- Standby Generation
- Rate Schedule CS -- Curtailable Service
- Rider J: Interruptible Electric Water Heater Service

Dominion annually projects both the summer and winter peak power (in MW) and annual energy requirements (in gigawatt-hours or GWH) impacts of DSM. The 1999 projections showed that, by the year 2007, Dominion planned to reduce peak power requirements in the summer and winter by 74 and 130 MW, respectively. Energy requirements in the same year would be reduced by 14 GWH, 94 percent of which would be from load management programs.

This represents a decrease in DSM initiatives that have been in effect for the past 30 years. Market conditions which provided the initial support for utility-sponsored conservation and load management efforts during the late 1970s and early 1980s, can be broadly characterized by:

- Increasing long-term marginal prices for capacity and energy-production resources
- Forecasts projecting increasing demand for electricity across the nation
- General agreement that the first two conditions would continue for the foreseeable future
- Limited competition in the generation of electricity

- Economies of scale in the generation of electricity which supported the construction of large central power plants, and
- Use of average embedded cost as the basis for setting electricity prices within a regulated context.

These market and regulatory conditions are undergoing dramatic changes. The changes, which have significantly impacted the cost-effectiveness of utility-sponsored DSM, can be described as follows:

- A decline in generation costs, due primarily to technological advances that have reduced the cost of constructing new generating units (e.g., combustion turbines), and
- National energy legislation that has encouraged wholesale competition through open access to the transmission grid, as well as state legislation designed to facilitate retail competition.

Consistent with the two points above, the utility planning environment features lower capacity and lower energy prices than during earlier periods, shorter planning horizons, lower reserve margins, and increased reliance on market prices to direct utility resource planning. This, in turn, has greatly reduced the number of cost-effective DSM alternatives.

Other significant changes include:

- Rate designs programs that enable customers to make energy choices based on their unique energy needs and costs. An example is Dominion's hourly Real Time Pricing rate. Such rate designs will increasingly replace incentive-driven direct load-control programs.
- The adoption of increasingly stringent national appliance standards for most major energy-using equipment and the adoption of energy efficiency requirements in state building codes. These mandates have further reduced the potential for cost-effective utility-sponsored measures.
- Third parties are increasingly providing energy services and products in competitive markets at prices that reflect their value to the customer. Market conditions can be expected to continue this shift among providers of cost-effective load management.

For these reasons, Dominion determined that the remaining DSM programs, which are primarily directed toward load management, are not an effective substitute for any of its large base-load units operating at high capacity factors, including NAPS.

7.2.2 Environmental Impacts of Alternatives

This section evaluates the environmental impacts from generation strategies that Dominion has determined to be reasonable [NEPA] alternatives to NAPS license renewal: coal- and gas-fired generation at the NAPS site and purchased power.

7.2.2.1 Coal-fired Generation

The NRC evaluated environmental impacts from coal-fired generation alternatives in the GEIS (Ref. 7.0-1, Section 8.3.9). NRC concluded that construction impacts could be substantial, due in part to the large amount of land required, which could result in natural habitat loss, and also to the large workforce needed. NRC pointed out that siting a new coal-fired plant where a nuclear plant is already located would reduce many construction impacts. NRC identified major adverse impacts from operations as: human health concerns associated with air emissions; waste generation; and losses of aquatic biota due to cooling water withdrawals and discharges.

The coal-fired alternative that Dominion has defined in Section 7.2.1.1 would be located at the existing NAPS site on previously disturbed land, thereby reducing construction impacts. The alternative also would use the existing cooling water system, thereby reducing aquatic impacts from operations. Therefore, Dominion has limited its detailed evaluation to air emissions and associated waste generation in the form of ash and scrubber waste.

Air Quality

Air quality impacts of coal-fired generation are considerably different from those of nuclear power. A coal-fired plant would emit sulfur oxides, nitrogen oxides, carbon monoxide, and particulate matter (PM), all of which are regulated pollutants. As Section 7.2.1.1 indicates, Dominion has assumed a plant design that would minimize air emissions. Reduced air emissions result from a combination of boiler technology and post-combustion pollutant removal. Dominion estimates the coal-fired alternative emissions to be as follows:

Sulfur oxides = 4,548 tons per year

Nitrogen oxides = 1,185 tons per year

Carbon monoxide = 1,221 tons per year

Particulates:

Total suspended particulates = 261 tons per year

PM_{10} (particulates having a diameter of less than 10 microns) = 60 tons per year

Table 7-3 presents the equations Dominion used to calculated these emissions. Nationally, emissions of sulfur dioxide and nitrogen oxides from Virginia's generators ranked 20th and 28th respectively. Emissions of both pollutants increased from 1986 to 1996. Although no Virginia generators were mentioned in Title IV of the Clean Air Act Amendments of 1990, it is likely that Virginia's Department of Environmental Quality will need to design a state implementation plan for reducing groundlevel ozone in response to a proposal released by the U.S. Environmental Protection Agency (EPA) in October 1998. The EPA proposal does not mandate which sources must reduce pollution. However, the EPA states that utilities would be one of the most likely sources of nitrogen oxides emissions reductions. Virginia is also part of the Ozone Transport Commission. Each of the 13 states of the Ozone Transport Commission is responsible for: enacting regulations in order to achieve region-wide nitrogen oxides reductions in a consistent, enforceable manner; and allocating its nitrogen oxides Budget Program allowances among nitrogen oxides sources in the State. The targets in this program are all electricity- generating facilities with a rated output of 15 MW or more and large industrial boilers (Ref. 7.2-1, pg. 281).

The Clean Air Act Amendments capped the nation's sulfur dioxide emissions from power plants, and each utility was allocated sulfur dioxide allowances. To be in compliance with the Act, Dominion must hold enough allowances to cover its annual sulfur dioxide emissions. Dominion would have to purchase additional allowances from the open market if it did not have enough surplus allowances to operate an additional fossil-burning plant at the NAPS site. Nitrogen oxides emissions are also controlled under the Act, and utilities often have to purchase offsets to remain in compliance. Operation of a coal-fired plant may require that Dominion purchase nitrogen offsets.

NRC did not quantify coal-fired emissions, but implied that air impacts would be substantial. The NRC noted that adverse human health effects from coal combustion have led to important federal legislation in recent years and that public health risks, such as cancer and emphysema, have been associated with coal combustion. The NRC also mentioned global warming and acid rain as potential impacts. Dominion concludes that federal legislation and large-scale concerns,

such as global warming and acid rain, are indications of concerns about destabilizing important attributes of air resources. However, sulfur oxide emission allowances, nitrogen oxides emission offsets, low nitrogen oxide burners, overfire air, selective catalytic reduction, fabric filters or electrostatic precipitators, and scrubbers are regulatorily-imposed mitigation measures. As such, Dominion concludes that the coal-fired alternative would have moderate impacts on air quality; the impacts would be clearly noticeable, but would not destabilize air quality in the area.

Waste Management

Dominion concurs with the GEIS assessment that the coal-fired alternative would generate substantial solid waste. The coal-fired plant would annually consume approximately 4,884,600 tons of coal having an ash content of 10.7 percent (Tables 7-3 and 7-1). After combustion, most (99.9 percent) of this ash, approximately 522,130 tons per year, would be collected and disposed of onsite. In addition, approximately 243,930 tons of scrubber sludge would be disposed of onsite each year (based on annual lime usage of 83,750 tons). Based on a standard 30-foot waste pile, Dominion estimates that ash and scrubber waste disposal over the 40-year plant life would require approximately 425 acres (an area approximately 4,300 feet square). The NAPS site is 1,075 acres, excluding the part of Lake Anna that is within the exclusion area. While only half of this waste volume and land use (213 acres) would be attributable to the 20-year license renewal period alternative, the total numbers are pertinent as a cumulative impact.

Dominion believes that, with proper siting and waste management and monitoring practices, waste disposal would not destabilize any resources. There is space within the NAPS footprint for this disposal. Most of the required land would require converting approximately 200 acres per year of second-growth mixed pine hardwoods to waste disposal facilities during the 20-year license renewal term. After closure of the waste site and revegetation, the land would be available for other uses. For these reasons, Dominion believes that waste disposal for the coal-fired alternative would have moderate impacts; the impacts would be clearly noticeable, but would not destabilize any important resource, and that further mitigation would be unwarranted.

Other Impacts

Construction of the powerblock and coal storage area would impact some land area and associated terrestrial habitat but, because some of this is a previously

disturbed area at an existing industrial site making maximum use of existing facilities, impacts would be minimal. Visual impacts would be consistent with the industrial nature of the site. As with any large construction project, some erosion and sedimentation and fugitive dust emissions could be anticipated, but would be minimized by using best management practices. Construction debris from clearing and grubbing could be disposed of onsite and municipal waste disposal capacity is available. Socioeconomic impacts from the construction workforce would be minimal, because worker relocation would not be expected due to the proximity to a nearby metropolitan area, Richmond. Cultural resource impacts would not be expected, due to the previously disturbed nature of the site.

However, as land is cleared for waste disposal, Dominion would identify any cultural resources (e.g., historical places and archaeological sites) and develop mitigation plans for affected resources in consultation with the Virginia State Historical Preservation Officer.

Operation using the existing cooling canal system would minimize impacts to aquatic resources and water quality. The additional stacks, boilers, and rail deliveries would be an incremental addition to the visual impact from existing NAPS structures and operations. Socioeconomic impacts could result from the decrease in operational workforce from approximately 500 employees at NAPS to approximately 200 employees needed to operate the coal facility. Dominion believes these impacts would be small to moderate and would be mitigated by the site's proximity to a large metropolitan area (Richmond).

Dominion believes that the other construction and operation impacts would be small. In some cases, the impacts would not be detectable and, in all cases, they would be minor and would neither destabilize nor noticeably alter any important attribute of the resource involved. Due to the minor nature of these other impacts, mitigation would not be warranted beyond that mentioned.

7.2.2.2 Gas-Fired Generation

NRC evaluated environmental impacts from gas-fired generation alternatives in the GEIS, focusing on combined-cycle plants. Section 7.2.1.1 presents Dominion's reasons for defining the gas-fired generation alternative as a combined cycle plant on the NAPS site. Land-use impacts from gas-fired units would be less than those of the coal-fired alternative at NAPS. Reduced land requirements, due to construction on the existing site and a smaller facility footprint, would reduce impacts to other resources as well: ecological, aesthetic, and cultural. A smaller workforce would have minor adverse socioeconomic

impacts. Human health concerns associated with air emissions, waste generation, and aquatic biota losses due to cooling water withdrawals and discharges would all be impacts of concern.

The NRC has evaluated the environmental impacts of constructing and operating four 440-MW combined-cycle gas-fired units as an alternative to nuclear power plant license renewal (Ref. 7.2-9). The NRC analysis is for more than the NAPS gas-fired alternatives analysis because Dominion would install only three 508-MW units. Dominion has independently calculated the gas-fired emissions for the standard combined-cycle units introduced in Section 7.2.1.1, but has adopted the rest of the NRC analysis with necessary Virginia- and Dominion-specific modifications noted.

Air Quality

Natural gas is a relatively clean-burning fuel; the gas-fired alternative would release similar types of emissions, but in lesser quantities than the coal-fired alternative. Control technology for gas-fired turbines focuses on nitrogen oxides emissions. Dominion estimates the gas-fired alternative emissions to be as follows:

Sulfur oxides = 134 tons per year

Nitrogen oxides = 506 tons per year

Carbon monoxide = 664 tons per year

Filterable particulates = 198 tons per year (all particulates are PM_{10})

Table 7-4 provides the equations used by Dominion to calculate these emissions.

The Section 7.2.2.1 discussion of regional air quality and Clean Air Act requirements is also applicable to the gas-fired generation alternative. Nitrogen oxides' effects on ozone levels, sulfur dioxide allowances, and nitrogen oxides emission offsets could all be issues of concern for gas-fired combustion. While gas-fired turbine emissions are less than coal-fired boiler emissions, and regulatory requirements are less stringent, the emission are still substantial.

Dominion concludes that emissions from the gas-fired alternative located at NAPS would noticeably alter local air quality, but would not destabilize regional resources. Air quality impacts would therefore be moderate, but substantially smaller than those of coal-fired generation.

Waste Management

Gas-fired generation would result in almost no waste generation and produce minor, if any, impacts. Dominion concludes that gas-fired generation waste management impacts would be small.

Other Impacts

As is true for the coal-fired alternative, constructing the gas-fired alternative on an existing site (such as NAPS) would reduce construction-related impacts. NRC estimated in the GEIS that 110 acres would be needed for a plant site; this much previously disturbed acreage is available within the boundaries of NAPS, reducing loss of terrestrial habitat. Aesthetic impacts, erosion and sedimentation, fugitive dust, and construction debris impacts would be similar to the coal-fired alternative, but smaller due to the reduced site size. Socioeconomic impacts of construction would be minimal. However, the GEIS estimates a work force of 150 for gas operations. The reduction in work force could result in adverse socioeconomic impacts. Dominion believes these impacts would be moderate and would be mitigated by the site's proximity to a large metropolitan area.

One costly (about $40 million) controversial (not-in-my-backyard) action with potential ecological impacts would be the installation of approximately 40 miles of a buried 24-inch gas pipeline line from Gordonsville, Virginia, to NAPS. The pipeline would require an additional 727 acres (40 miles x 150 foot easement = 727 acres). Dominion would mitigate the political impacts through public hearings and apply best management practices during construction, such as minimizing soil loss and restoring vegetation immediately after the excavation is backfilled.

Construction would result in the loss of some less mobile animals (e.g., toads and turtles). Because these animals are common throughout the area, Dominion expects negligible reduction in their population as a result of construction. Dominion does not expect that installation of the pipeline would create a long-term reduction in the local or regional diversity of plants and animals.

Cultural Resources

Gas pipeline construction could require cultural resource preservation measures. Dominion anticipates that these measures would result in no detectable change in cultural resources, and that the effects would be minor and not exert a destabilizing influence on this resource. Dominion concludes that impacts to cultural resources would be small, if any.

7.2.2.3 Purchased Power

As discussed in Section 7.2.1.2, Dominion assumes that the generating technology used under the purchased power alternative would be one of those that NRC analyzed in the GEIS. Dominion is also adopting by reference the NRC analysis of the environmental impacts from those technologies. Therefore, under the purchased power alternative, environmental impacts would still occur, but would be located elsewhere within the region, nation, or Canada.

The purchased power alternative would include adding approximately 100 miles of 500-kV transmission lines to enable Dominion to get out-of-state power from its nearest substation to the NAPS load center. This could involve a 100-mile by 300-foot easement (6 square miles) of land-use change with associated terrestrial ecological impacts. Dominion assumes that the environmental impacts of transmission line construction would be approximately equal to those of the Joshua Falls 500-kV interconnect to Ladysmith. Similarly, the environmental impacts of new (offsite) generating capacity would be similar to the environmental impacts of construction and operation of the Remington Combustion Turbine Site, but three sites the size of the Remington site would be required to replace the NAPS power. Loss of the NAPS workforce could result in adverse impacts. Dominion believes these impacts would be moderate and would be mitigated by the site's proximity to large metropolitan areas (Richmond, Charlottesville, and Fredericksburg, VA).

TABLES AND FIGURES

Table 7-1
Coal-Fired Alternative

Characteristic	Basis
Unit size = 508 MW ISO rating net[a]	Chosen for comparability to a standard size gas-fired combined-cycle turbine
Unit size = 538 MW ISO rating gross[a]	Calculated based on 6 percent onsite power usage (Dominion experience): 508 MW x 1.06
Number of units = 3	Calculated to be ≤ NAPS Units 1 and 2 gross capacity of approximately 1,964 MW
Boiler type = tangentially fired, dry-bottom	Minimizes nitrogen oxides emissions (Ref. 7.2-11, Table 1.1-3, pg. 1.1-17).
Fuel type = bituminous, pulverized coal	Typical for coal used in Virginia (Dominion experience)
Fuel heating value = 12,559 Btu/lb	1998 value for coal used in Virginia (Ref. 7.2-12)
Fuel ash content by weight = 10.7 percent	1998 value for coal used in Virginia (Ref. 7.2-12)
Fuel sulfur content by weight = 0.98 percent	1998 value for coal used in Virginia (Ref. 7.2-12)
Uncontrolled NO_x emission = 9.7 lb/ton Uncontrolled CO emission = 0.5 lb/ton	Typical for pulverized coal, tangentially fired, dry-bottom, Pre-NSPS with low-NO_x burner (Ref. 7.2-11, Table 1.1-3 pg. 1.1-17)
Heat rate = 10,200 Btu/KWh	Typical for coal-fired, single cycle steam turbines (Ref. 7.2-13, pg. 106)
Capacity factor = 0.85	Typical for large coal-fired units (Dominion experience)
NO_x control = low NO_x burners with overfire air and selective catalytic reduction (95 percent reduction)	Best available for minimizing NO_x emissions (Dominion experience and Ref. 7.2-11, Table 1.1-2, pg. 1.1-14).
Particulate control = fabric filters or electrostatic precipitators (99.9 percent removal efficiency)	Best available for minimizing particulate emissions (Ref. 7.2-11, pp. 1.1-6 and -7)
SO_x control = Wet scrubber-lime/limestone (95 percent removal efficiency)	Best available for minimizing SO_x emissions (Ref. 7.2-11, Table 1.1-1, pg. 1.1-13)

a. The difference between "net" and "gross" is electricity consumed onsite.

Btu = British thermal unit
CO = carbon monoxide
ISO rating = International Standards Organization rating at standard atmospheric conditions of 59°F, 60 percent relative humidity, and 14.696 pounds of atmospheric pressure per square inch
kWh = kilowatt hour
NSPS = New Source Performance Standard
lb = pound
MW = megawatt
NO_X = nitrogen oxides
SO_x = sulfur oxides

Table 7-2
Gas-Fired Alternative

Characteristic	Basis
Unit size = 508 MW ISO rating net:[a] Two 168-MW combustion turbines and a 172-MW heat recovery boiler	Manufacturer's standard-size gas-fired combined-cycle plant
Unit size = 528 MW ISO rating gross:[a] Two 174.7-MW combustion turbines and a 179-MW heat recovery boiler (emission from two combustion turbines only)	Calculated based on 4 percent onsite power usage (Dominion experience): 508 MW × 1.04
Number of units = 3	Calculated to be ≤ NAPS Units 1 and 2 gross core capacity of approximately 1,964 MW
Fuel type = natural gas	Assumed
Fuel heating value = 1,059 Btu/ft^3	Typical for natural gas used in Virginia (Ref. 7.2-12)
Fuel sulfur content = 0.0034 lb/MMBtu	Used when sulfur content is not available (Ref. 7.2-14, Table 3.1-2a, pg. 3.1-11)
NO_X control = low NO_x and selective catalytic reduction (SCR)	Typical for large SCR-controlled gas-fired units (Ref. 7.2-14, Section 3.1.4.3, pg. 3.1-7)
Fuel NO_x content = 0.0128 lb/MMBtu	Typical for large SCR-controlled gas-fired units (Ref. 7.2-16)
Fuel CO content = 0.0168 lb/MMBtu	Typical for large SCR-controlled gas-fired units (Ref. 7.2-16)
Heat rate = 6,700 Btu/kWh	Dominion Power experience
Capacity factor = 0.85	Typical for large gas-fired base load units (Dominion experience)

a. The difference between "net" and "gross" is electricity consumed onsite.

Btu = British thermal unit
CO = carbon monoxide
ft3 = cubic foot
ISO rating = International Standards Organization rating at standard atmospheric conditions of 59°F, 60 percent relative humidity, and 14.696 pounds of atmospheric pressure per square inch
kWh = kilowatt hour
MM = million
MW = megawatt
NO_X = nitrogen oxides

Table 7-3
Air Emissions from Coal-Fired Alternative

Parameter	Calculation	Result
Annual coal consumption	$3\ units \times \frac{538\ MW}{unit} \times \frac{10,200\ Btu}{kW \times hr} \times \frac{1,000\ kw}{MW} \times \frac{lb}{12,559\ Btu} \times \frac{ton}{2,000\ lb} \times 0.85 \times \frac{24\ hr}{day} \times \frac{365\ day}{yr}$	4,884,600 tons per year
SO_x[a, c]	$\frac{38 \times 0.98\ lb}{ton} \times \frac{ton}{2,000\ lb} \times (1 - [95/100]) \times \frac{4,884,600\ tons}{yr}$	4,548 tons SO_2 per year
NO_x[b, c]	$\frac{9.7\ lb}{ton} \times \frac{ton}{2,000\ lb} \times (1 - [95/100]) \times \frac{4,884,600\ tons}{yr}$	1,185 tons NO_x per year
CO[c]	$\frac{0.5\ lb}{ton} \times \frac{ton}{2,000\ lb} \times \frac{4,884,600\ tons}{yr}$	1,221 tons CO per year
TSP[d]	$\frac{10 \times 10.7\ lb}{ton} \times \frac{ton}{2,000\ lb} \times (1 - [99.9/100]) \times \frac{4,884,600\ tons}{yr}$	261 tons TSP per year
PM_{10}[d]	$\frac{2.3 \times 10.7\ lb}{ton} \times \frac{ton}{2,000\ lb} \times (1 - [99.9/100]) \times \frac{4,884,600\ tons}{yr}$	60 tons PM_{10} per year

a. Ref. 7.2-11, Table 1.1-1.
b. Ref. 7.2-11, Table 1.1-2.
c. Ref. 7.2-11, Table 1.1-3.
d. Ref. 7.2-11, Table 1.1-4.

CO = carbon monoxide
NO_x = oxides of nitrogen
PM_{10} = particulates having diameter less than 10 microns
SO_x = sulfur oxides
TSP = total suspended particulates

Table 7-4
Air Emissions from Gas-Fired Alternative

Parameter	Calculation	Result
Annual gas consumption	$3\ units \times \frac{528\ MW}{unit} \times \frac{6,700\ Btu}{kW \times hr} \times \frac{1,000\ kW}{MW} \times 0.85 \times \frac{ft^3}{1,059 Btu} \times \frac{24\ hr}{day} \times \frac{365\ day}{yr}$	74,665,534,912 ft^3 per year
Annual Btu consumption	$\frac{74,665,534,912\ ft^3}{yr} \times \frac{1,059 Btu}{ft^3} \times \frac{MMBtu}{10^6 Btu}$	79,070,801 MMBtu per year
SO_x[a]	$\frac{0.0034\ lb}{MMBtu} \times \frac{ton}{2,000\ lb} \times \frac{79,070,801\ MMBtu}{yr}$	134 tons SO_2 per year
NO_x[b]	$\frac{0.0128\ lb}{MMBtu} \times \frac{ton}{2,000\ lb} \times \frac{79,070,801\ MMBtu}{yr}$	506 tons NO_x per year
CO[b]	$\frac{0.0168\ lb}{MMBtu} \times \frac{ton}{2,000\ lb} \times \frac{79,070,801\ MMBtu}{yr}$	664 tons CO per year
TSP[c]	$\frac{0.005\ lb}{MMBtu} \times \frac{ton}{2,000\ lb} \times \frac{79,070,801\ MMBtu}{yr}$	198 tons filterable TSP per year
PM_{10}[c]	$\frac{198\ tons\ TSP}{yr}$	198 tons filterable PM_{10} per year

a. Ref. 7.2-14, Table 3.1-2a.
b. Ref. 7.2-16, emission factor report for NO_x and CO using natural gas and SCR.
c. Ref. 7.2-17.
CO = carbon monoxide
NO_x = oxides of nitrogen
PM_{10} = particulates having diameter less than 10 microns
SO_x = sulfur oxides
TSP = total suspended particulates

Figure 7-1
Utility Generating Capability by Primary Energy Source, 1996
(Ref. 7.2-1, Figure 1)

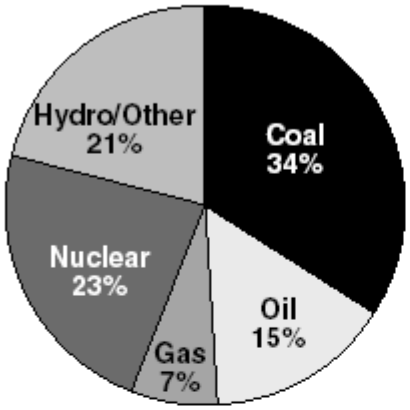


Figure 7-2
Utility Generation by Primary Energy Source, 1996
(Ref. 7.2-1, Figure 2)

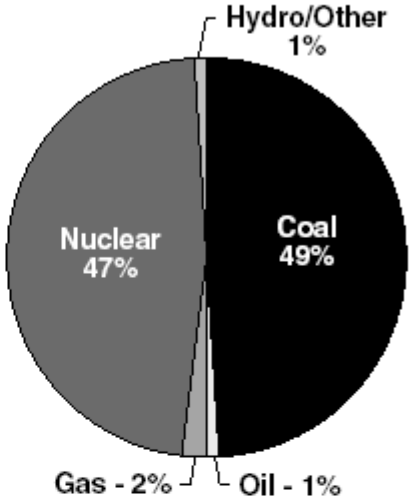
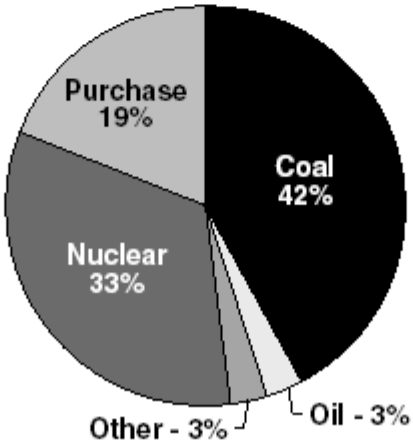


Figure 7-3
Dominion's 1998 Electricity Generating Capability
(Ref. 7.1-1)



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Ref. 7.2-15 Virginia Power/North Carolina Power. 1999. *Integrated Resource Plan 1996-2000*.

Ref. 7.2-16 U. S. Environmental Protection Agency. 2000. *AP-42: Section 3.1: Data File data_3_1_mdb.* Available at http://www.epa.gov/ttn/chief/C0301.html. Accessed July 25, 2000.

Ref. 7.2-17 Pollution Engineering Online. 1998. Particulate Matter: Predicting its Emission Rates. Available at http://www.pollutioneng.com. Accessed December 27, 2000.

8.0 COMPARISON OF ENVIRONMENTAL IMPACTS OF LICENSE RENEWAL WITH THE ALTERNATIVES

8.1 Discussion

NRC Input

"To the extent practicable, the environmental impacts of the proposal and the alternatives should be presented in comparative form..." 10 CFR 51.45(b)(3) as adopted by 51.53(c)(2)

Chapter 4 analyzes environmental impacts for North Anna Power Station (NAPS) Units 1 and 2 and Chapter 7 analyzes impacts from renewal alternatives. Table 8-1 summarizes environmental impacts of the proposed action, license renewal, and the feasible alternatives so the reader can compare them. The environmental impacts compared in Table 8-1 are those that are either Category 2 issues for the proposed action (license renewal) or are issues that the *Generic Environmental Impact Statement for License Renewal of Nuclear Plants* (GEIS) (Ref. 8.1-1) identified as major considerations in an alternatives analysis. For example, although the U.S. Nuclear Regulatory Commission (NRC) concluded that air impacts from the proposed action would be small (Category 1), the GEIS identified major human health concerns associated with air emissions from alternatives (Section 7.2.2.1). Therefore, Table 8-1 compares air impacts among the proposed actions and the alternatives. Table 8-2 is a more detailed comparison of the alternatives.

[picture not included] North Anna Power Station Units 1 and 2

Table 8-1
Impacts Comparison Summary

Impact Area	Proposed Action (License Renewal)	No Action Alternative			
		Base (Decommissioning)	With Coal-Fired Generation	With Gas-Fired Generation	With Purchased Power
Land Use	SMALL	SMALL	SMALL	SMALL	MODERATE
Water Quality	SMALL	SMALL	SMALL	SMALL	SMALL to MODERATE
Air Quality	SMALL	SMALL	MODERATE	MODERATE	SMALL to MODERATE
Ecological Resources	SMALL	SMALL	SMALL to MODERATE	SMALL	SMALL to MODERATE
Threatened or Endangered Species	SMALL	SMALL	SMALL	SMALL	SMALL
Human Health	SMALL	SMALL	MODERATE	SMALL	SMALL to MODERATE
Socioeconomics	SMALL	SMALL	SMALL to MODERATE	MODERATE	MODERATE
Waste Management	SMALL	SMALL	MODERATE	SMALL	SMALL to MODERATE
Aesthetics	SMALL	SMALL	SMALL	SMALL	SMALL to MODERATE
Cultural Resources	SMALL	SMALL	SMALL	SMALL	SMALL

SMALL - Environmental effects are not detectable or are so minor that they will neither destabilize nor noticeably alter any important attribute of the resource. MODERATE - Environmental effects are sufficient to alter noticeably, but not to destabilize, any important attribute of the resource. (10 CFR 51, Subpart A, Appendix B, Table B-1, Footnote 3.)

Table 8-2
Impacts Comparison Detail

Proposed Action (License Renewal)	No Action Alternative			
	Base (Decommissioning)	With Coal-Fired Generation	With Gas-Fired Generation	With Purchased Power
	Description of Action			
NAPS license renewals for 20 years each, followed by decommissioning	Decommissioning following expiration of current NAPS licenses Adopting by reference, as bounding NAPS decommissioning, GEIS description of action (Section 7.1)	New construction at the NAPS site	New construction at the NAPS site Construct 40 miles of gas pipeline in a 150-foot wide corridor	Construct one additional 500-kV transmission line Could involve construction of new generation capacity out of state Adopting by reference GEIS description of alternate technologies (Section 7.2.1.2)
		Three 508-MWe (net) tangentially-fired dry bottom units; capacity factor 0.85	Three 508-MWe (net) units: each consisting of two 168-MW combustion turbines and a 172-MW heat recovery boiler; capacity factor 0.85	
		Existing intake/discharge canal and Waste Heat Treatment Facility	Existing intake/discharge canal and Waste Heat Treatment Facility	
		Pulverized bituminous coal, 12,559 Btu/pound; 10,200 Btu/kWh; 10.7% ash; 0.98% sulfur; 0.10 lb/MMBtu nitrogen oxides; 4,884,600 tons coal/yr	Natural gas, 1,059 Btu/ft^3; 6,700 Btu/kWh; 0.0006 lb sulfur/MMBtu; 0.0128 lb NO_x/MMBtu; 49,385,078,210 ft^3 gas/yr	
		Low NO_x burners, with over-fire air and selective catalytic reduction (95% No_x reduction efficiency)	Low NO_x burners, selective catalytic reduction	

Table 8-2 (continued)
Impacts Comparison Detail

Proposed Action (License Renewal)	No Action Alternative			
	Base (Decommissioning)	With Coal-Fired Generation	With Gas-Fired Generation	With Purchased Power
		Wet scrubber - lime/limestone desulfurization system; flue gas (95% SO_x removal efficiency): 84,000 tons limestone/yr Fabric filters or electrostatic precipitators (99.9% particulate removal efficiency) 200 workers (Section 7.2.2.1)	 150 workers (Section 7.2.2.2)	
		Land Use Impacts		
SMALL – Adopting by reference Category 1 issue findings (Table 4-2, Issues 52, 53)	SMALL – Not an impact evaluated by GEIS (Ref. 8.1-1, Section 7.3)	SMALL – 213 acres on existing site for 20 years of ash and scrubber sludge disposal (Section 7.2.2.2)	SMALL – 110 acres for facility on previously disturbed land; 730 acres for pipeline adjacent to existing previously disturbed easements if available; (Section 7.2.2.2)	MODERATE – 6 square miles for one 500-kV transmission line and transmission facilities (Section 7.2.2.3) Adopting by reference GEIS description of land use impacts from alternate technologies (Ref. 8.1-1, Section 8.2)
		Water Quality Impacts		
SMALL – Adopting by reference Category 1 issue findings (Table 4-2, Issues 3, 5, 6, 7-12, 32). Category 2 water-use-conflicts and groundwater issues not applicable (Section 4.1, Issue 13; Section 4.5, Issue 33; Section 4.6, Issue 34; Section 4.7, Issue 35; and Section 4.8, Issue 39)	SMALL – Adopting by reference Category 1 issue finding (Table 4-2, Issue 89)	SMALL – Construction impacts minimized by use of best management practices. Operation impacts minimized by use of existing intake/discharge system (Section 7.2.2.1)	SMALL – Reduced cooling water demands inherent in combined-cycle design and use of closed cycle cooling minimizes impacts (Section 7.2.2.2)	SMALL to MODERATE – Adopting by reference GEIS description of water quality impacts from alternate technologies (Ref. 8.1-1, Section 8.2)

Table 8-2 (continued)
Impacts Comparison Detail

Proposed Action (License Renewal)	No Action Alternative			
	Base (Decommissioning)	With Coal-Fired Generation	With Gas-Fired Generation	With Purchased Power
Air Quality Impacts				
SMALL – Adopting by reference Category 1 issue finding (Table 4-2, Issue 51). Category 2 issue not applicable (Section 4.11, Issue 50)	SMALL – Adopting by reference Category 1 issue findings (Table 4-2, Issue 88)	MODERATE – • 4,548 tons SO_x/yr • 1,185 tons NO_x/yr • 1,221 tons CO/yr • 261 tons TSP/yr • 60 tons PM_{10}/yr (Section 7.2.2.1)	MODERATE – • 134 tons SO_x/yr • 506 tons NO_x/yr • 664 tons CO/yr • 198 tons PM_{10}/yr[a] (Section 7.2.2.2)	SMALL to MODERATE – Adopting by reference GEIS description of air quality impacts from alternate technologies (Ref. 8.1-1, Section 8.2)
Ecological Resource Impacts				
SMALL – Adopting by reference Category 1 issue findings (Table 4-2, Issues 15, 24, 45-48). One Category 2 issue not applicable (Section 4.9, Issue 40). Dominion holds a current VPDES permit, which constitutes compliance with Clean Water Act Section 316(b) (Section 4.2, Issue 25; Section 4.3, Issue 26). Dominion holds a current VPDES permit with a variance for thermal releases from NAPS.	SMALL – Adopting by reference Category 1 issue finding (Table 4-2, Issue 90)	SMALL TO MODERATE – 213 acres of forested or previously disturbed land could be required for ash/sludge disposal over 20 year license renewal term (Section 7.2.2.1)	SMALL – Construction of 40 miles of the new gas pipeline could alter habitat. (Section 7.2.2.2)	SMALL to MODERATE – Adopting by reference GEIS description of ecological resource impacts from alternate technologies (Ref. 8.1-1, Section 8.2)
Threatened and Endangered Species Impacts				
SMALL - Impacts to threatened and endangered species have been positive (Section 4.10, Issue 49)	SMALL – Not an impact evaluated by GEIS (Ref. 8.1-1, Section 7.3)	SMALL – Federal and state laws prohibit destroying or adversely affecting protected species and their habitats	SMALL – Federal and state laws prohibit destroying or adversely affecting protected species and their habitats	SMALL – Federal and state laws prohibit destroying or adversely affecting protected species and their habitats

Table 8-2 (continued)
Impacts Comparison Detail

Proposed Action (License Renewal)	No Action Alternative			
	Base (Decommissioning)	With Coal-Fired Generation	With Gas-Fired Generation	With Purchased Power
		Human Health Impacts		
SMALL – Adopting by reference Category 1 issue findings (Table 4-2, Issues 58, 60, 61, 62). Risk from microbiological organisms minimal due to water temperatures below optimal for growth and wastewater disinfection practices (Section 4.12 Issue 57). Risk due to transmission-line induced currents minimal due to conformance with consensus code (Section 4.13, Issue 59)	SMALL – Adopting by reference Category 1 issue finding (Table 4-2, Issue 86)	MODERATE – Adopting by reference GEIS conclusion that risks such as cancer and emphysema from emissions are likely (Ref. 8.1-1, Section 8.3.9)	SMALL – Adopting by reference GEIS conclusion that some risk of cancer and emphysema exists from emissions (Ref. 8.1-1, Table 8-2)	SMALL to MODERATE – Adopting by reference GEIS description of human health impacts from alternate technologies (Ref. 8.1-1, Section 8.2)
		Socioeconomics Impacts		
SMALL – Adopting by reference Category 1 issue findings (Table 4-2, Issues 64, 67). Two Category 2 issues not applicable (Section 4.16, Issue 66 and Section 4.17.1, Issue 68). NAPS located in medium population area not subject to growth control measures that limit housing (Section 4.14, Issue 63). Plant contribution is 2.2 percent of Louisa County tax base, minimizing potential for land use impacts (Section 4.17.2, Issue 69). Capacity of public water supply and transportation services minimizes potential for related impacts (Section 4.15, Issue 65 and Section 4.18, Issue 70)	SMALL – Adopting by reference Category 1 issue finding (Table 4-2, Issue 91)	SMALL to MODERATE – Reduction in permanent work force could adversely affect surrounding counties (Section 7.2.2.1)	MODERATE – Reduction in permanent work force could adversely affect surrounding counties (Section 7.2.2.2)	MODERATE – Adopting by reference GEIS description of socioeconomic impacts from alternate technologies (Ref. 8.1-1, Section 8.2)

Table 8-2 (continued)
Impacts Comparison Detail

Proposed Action (License Renewal)	No Action Alternative			
	Base (Decommissioning)	With Coal-Fired Generation	With Gas-Fired Generation	With Purchased Power
Waste Management Impacts				
SMALL – Adopting by reference Category 1 issue findings (Table 4-2, Issues 77-85)	SMALL – Adopting by reference Category 1 issue finding (Table 4-2, Issue 87	MODERATE – Annually generate 522,000 tons of coal ash and 244,000 tons of scrubber sludge, requiring 213 acres over 20-year license renewal term. Industrial waste generated annually. (Section 7.2.2.1)	SMALL – Almost no waste generation (Section 7.2.2.2)	SMALL to MODERATE – Adopting by reference GEIS description of waste management impacts from alternate technologies (Ref. 8.1-1, Section 8.2)
Aesthetic Impacts				
SMALL – Adopting by reference Category 1 issue findings (Table 4-2, Issues 73, 74)	SMALL – Not an impact evaluated by GEIS (Ref. 8.1-1, Section 7.3)	SMALL – Incremental addition to existing structures and operations; new stacks and increased coal deliveries via rail would be visible to the public (Section 7.2.2.1)	SMALL – New steam turbines and associated stacks would create incremental visual impacts to those from existing NAPS facilities (Section 7.2.2.2)	SMALL to MODERATE – Adopting by reference GEIS description of aesthetic impacts from alternate technologies (Ref. 8.1-1, Section 8.2)
Cultural Resource Impacts				
SMALL – Lack of resources and SHPO consultation minimizes potential for impact (Section 4.19, Issue 71)	SMALL – Not an impact evaluated by GEIS (Ref. 8.1-1, Section 7.3)	SMALL – Impacts unlikely due to lack of resources onsite (Section 7.2.2.1)	SMALL – Forty miles of pipeline construction needed and location of pipeline, activities could impact some cultural resources (Section 7.2.2.2)	SMALL – Adopting by reference GEIS description of cultural resource impacts from alternate technologies (Ref. 8.1-1, Section 8.2)

a. All TSP for gas-fired alternative is PM_{10}.

SMALL - Environmental effects are not detectable or are so minor that they will neither destabilize nor noticeably alter any important attribute of the resource. MODERATE - Environmental effects are sufficient to alter noticeably, but not to destabilize any important attribute of the resource. 10 CFR 51, Subpart A, Appendix B, Table B-1, Footnote 3.

Btu = British thermal unit
ft^3 = cubic foot
gal = gallon
GEIS = Generic Environmental Impact Statement (Ref. 8.1-1)
kWh = kilowatt hour
lb = pound
MM = million
MW = megawatt
NO_x = nitrogen oxide
PM_{10} = particulates having diameter less than 10 microns
SHPO = State Historic Preservation Officer
SO_x = sulfur dioxide
TSP = total suspended particulates
yr = year

8.2 References

Ref. 8.1-1 U.S. Nuclear Regulatory Commission. 1996. *Generic Environmental Impact Statement for License Renewal of Nuclear Plants (GEIS)*. Volumes 1 and 2. NUREG-1437. Washington, DC.

9.0 STATUS OF COMPLIANCE

9.1 Proposed Action

NRC Input

"The environmental report shall list all Federal permits, licenses, approvals and other entitlements which must be obtained in connection with the proposed action and shall describe the status of compliance with these requirements. The environmental report shall also include a discussion of the status of compliance with applicable environmental quality standards and requirements including, but not limited to, applicable zoning and land-use regulations, and thermal and other water pollution limitations or requirements which have been imposed by Federal, State, regional, and local agencies having responsibility for environmental protection." 10 CFR 51.45(d), as required by 10 CFR 51.53(c)(2)

9.1.1 General

Table 9-1 lists environmental authorizations that Dominion has obtained for current North Anna Power Station (NAPS) operations. In this context, Dominion uses "authorizations" to include permits, licenses, approvals, and other entitlements. Dominion expects to continue renewing these authorizations during the current license period and through the U.S. Nuclear Regulatory Commission (NRC) license renewal period. Based on the new and significant information identification process described in Chapter 5.0, Dominion concludes that NAPS is in compliance with applicable environmental standards and requirements.

Table 9-2 lists additional environmental authorizations and consultations that would be conditions precedent to NRC renewal of the NAPS licenses to operate. As indicated, Dominion anticipates needing relatively few such authorizations and consultations. Sections 9.1.2 through 9.1.5 discuss some of these items in more detail.

9.1.2 Threatened or Endangered Species

Section 7 of the Endangered Species Act (16 USC 1531 et seq.) requires federal agencies to ensure that agency action is not likely to jeopardize any species that is listed or proposed for listing as endangered or threatened. Depending on the action involved, the Act requires consultation with the U.S. Fish and Wildlife Service (FWS) regarding effects on non-marine species, the National Marine Fisheries Service (NMFS) for marine species, or both. FWS and NMFS have issued joint procedural regulations in 50 CFR 402, Subpart B, that address consultation, and FWS maintains the joint list of threatened and endangered species in 50 CFR 17.

As discussed in Sections 2.5 and 4.10, only two threatened and endangered species (i.e., bald eagle and loggerhead shrike) are known to be present in the vicinity of NAPS.

Although not required of an applicant by federal law or by NRC regulation, Dominion has chosen to invite comment (letter dated April 12, 2000) from other federal or state agencies regarding potential effects that NAPS license renewal might have. Appendix C includes copies of correspondence between Dominion and FWS. Dominion did not consult with NMFS because species under the auspices of NMFS are not known to be in the NAPS vicinity. Dominion has corresponded with the Virginia Department of Game & Inland Fisheries regarding potential effects on Commonwealth-listed species; Appendix C also includes this correspondence. Dominion is awaiting agency's response.

9.1.3 Coastal Zone Management

The Federal Coastal Zone Management Act (16 USC 1451 et seq.) imposes requirements on an applicant for a federal license to conduct an activity that could affect a state's coastal zone. The Act requires the applicant to certify to the licensing agency that the proposed activity would be consistent with the state's Federally approved coastal zone management program (Ref. 9.1-1). Virginia has a federally approved coastal management program. NAPS, located in Louisa County, is not within the Virginia coastal zone, called Tidewater Virginia (Ref. 9.1-2). However, Spotsylvania County, located across Lake Anna from NAPS (Figure 2-5), is within Tidewater Virginia and, due to its proximity, NAPS could affect it. Appendix E contains the Dominion consistency certification for NAPS license renewal.

9.1.4 Historic Preservation Consultation

Section 106 of the National Historic Preservation Act (16 USC 470 et seq.) requires federal agencies having the authority to license any undertaking, prior to issuing the license, to take into account the effect of the undertaking on historic properties and to afford the Advisory Council on Historic Preservation an opportunity to comment on the undertaking. Council regulations provide for establishing an agreement with any State Historic Preservation Officer (SHPO) to substitute state review for Council review (35 CFR 800.7). Although not required of an applicant by federal law or NRC regulation, Dominion has chosen to invite comment by the Virginia SHPO (letter dated April 12, 2000) regarding potential effects that NAPS license renewal might have on historic or cultural resources. Appendix D includes a copy of the correspondence. Dominion is awaiting agency's response.

9.1.5 Water Quality (401) Certification

Federal Clean Water Act (CWA) Section 401 requires that applicants for a federal license to conduct an activity that might result in a discharge into navigable waters provide the licensing agency with a certification from the state that the discharge will comply with applicable CWA requirements (33 USC 1341). Dominion is applying to NRC for a license

(i.e., license renewal) for NAPS operations that result in discharges to the Lake Anna and North Anna River, navigable waterways, within the Commonwealth of Virginia.
The Commonwealth of Virginia has U.S. Environmental Protection Agency authorization to implement the National Pollution Discharge Elimination System within the state for facilities such as NAPS. Virginia State Water Control Board regulations require that each Virginia Pollutant Discharge Elimination System (VPDES) permit include conditions necessary to conform to Section 401 of the Clean Water Act (Ref. 9.1-3). Based on the regulatory language, it is Dominion's understanding that Commonwealth issuance of a VPDES permit constitutes Section 401 certification by the Commonwealth for the permitted activity.

Appendix B contains a copy of the NAPS VPDES permit. Dominion concludes that providing this permit to NRC satisfies the CWA Section 401 requirement to provide certification by the state.

9.2 Alternatives

NRC Input

"The discussion of alternatives in the report shall include a discussion of whether the alternatives will comply with such applicable environmental quality standards and requirements." 10 CFR 51.45(d) as required by 10 CFR 51.53(c)(2)

The coal-, gas- and purchased-power alternatives discussed in Section 7.2.1 probably could be constructed and operated so as to comply with all applicable environmental quality standards and requirements. Dominion notes, however, that increasingly stringent air quality protection requirements could make construction of a large new fossil-fuel-fired power plant not cost justified for base-load generation in many locations, when compared to the proposed action, license renewal.

TABLES

Table 9-1
Environmental Authorizations for Current NAPS Operations

Agency	Authority	Requirement	Number	Issue Date or Expiration Date	Activity Covered
U.S. Nuclear Regulatory Commission	Atomic Energy Act [42 USC 2011, et seq.]	License To Operate	NPF-4 (Unit 1) NPF-7 (Unit 2)	Expires 04/01/18 (Unit 1); 08/21/20 (Unit 2)	Operation of Units 1 and 2
U.S. Fish and Wildlife Service	Migratory Bird Treaty Act [16 USC 703 – 712]	Permit	MB705136-0	Issued 01/01/01 Expires 12/31/01	Removal of up to 15 osprey nests causing safety hazards
U.S. Department of Transportation	49 CFR 107, Subpart G	Registration	05300002 0241	Issued 06/05/00 Expires 06/30/01	Hazardous materials shipments
VDEQ	Federal Clean Water Act, Section 402 (33 USC 1342); 9 VAC 25-31-50	Permit	VA0052451	Issued 01/11/01 Expires 01/11/06	Plant and stormwater discharges
VDEQ	9 VAC 5-80-10	Permit	None	Issued 10/20/93 No expiration	Authorizes installation and operation of station blackout generator
VDEQ	Federal Clean Air Act, Title V (42 USC 7661 et seq.); 9 VAC 5-80-10	Permit	None	Issued 01/06/99 No expiration	Air emission source operation
VDEQ	9 VAC 5-20-160	Registration	40726	Annual re-certification	Air emissions sources
VDH	12 VAC 5-590-190	Permit	2109610	Issued 06/17/91; Revised 05/04/98	Authorizes operation of potable water supply system

Source: Modified from Ref. 9.1-1
NRC – U.S. Nuclear Regulatory Commission
VAC – Virginia Administrative Code
VDEQ – Virginia Department of Environmental Quality
VDH – Virginia Department of Health

Table 9-2
Environmental Authorizations for NAPS License Renewal[a]

Agency	Authority	Requirement	Remarks
U.S. Nuclear Regulatory Commission	Atomic Energy Act (42 USC 2011 et seq.)	License Renewal	Environmental Report submitted in support of license renewal application.
FWS	Endangered Species Act Section 7 (16 USC 1536)	Consultation	Requires federal agency issuing a license to consult with FWS. (Appendix C)
Virginia Department of Environmental Quality	Clean Water Act Section 401 (33 USC 1341)	Certification	NAPS VPDES permit constitutes State Certification. (Appendix B)
Virginia Department of Historic Resources	National Historic Preservation Act Section 106 (16 USC 470f)	Consultation	Requires Federal agency issuing a license to consider cultural impacts and consult with State Historic Preservation Officer. Awaiting SHPO response. (Appendix D)

a. No renewal-related requirements identified for local or other agencies.
FWS= U.S. Fish and Wildlife Service
NAPS=North Anna Power Station
VPDES=Virginia Pollutant Discharge Elimination System

9.3 References

Ref. 9.1-1 U.S. Nuclear Regulatory Commission. 1999. *Revision 2, Procedural Guidance for Preparing Environmental Assessments and Considering Environmental Issues*. Office of Nuclear Reactor Regulation.

Ref. 9.1-2 Virginia Administrative Code, Title 10.1 - Conservation Q Subtitle 10.1-100 Activities Administered by the Department of Conservation and Recreation, Chapter 1 - Administration. Available at http://leg1.state.va.us/cgi-bin/legp504.exe?000+cod+10.1-2101. Accessed May 15, 2000.

Ref. 9.1-3 Virginia Administrative Code, Title 9 – Environment, Agency 25 – State Water Control Board, Chapter 31 – Virginia Pollutant Discharge Elimination System (VPDES) Permit Regulation, Section 220 – Water quality standards and other permit conditions, Subsection D – Water quality standards and state requirements, Paragraph 3 (9 VAC 25-31-220[D][3]). Available at http://leg1.state.va.us/cgi-bin/legp504.exe?000+reg+9vac25-31-220. Accessed February 16, 2000.