8.0 Environmental Impacts of Alternatives to Operating License Renewal

This chapter examines the potential environmental impacts associated with denying the renewal of the operating licenses (OLs) (i.e., the no-action alternative); the potential environmental impacts from electric generating sources other than Surry Power Station, Units 1 and 2; the possibility of purchasing electric power from other sources to replace power generated by Units 1 and 2 and the associated environmental impacts; the potential environmental impacts from a combination of generation and conservation measures; and other generation alternatives that were deemed unsuitable for replacement of power generated by Units 1 and 2. The environmental impacts are evaluated using the U.S. Nuclear Regulatory Commission's (NRC's) three-level standard of significance—SMALL, MODERATE, or LARGE, as developed using the Council on Environmental Quality guidelines and set forth in a footnote to Table-B-1 of 10 CFR Part 51, Subpart A, Appendix B:

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 important attributes of the resource.

LARGE – Environmental effects are clearly noticeable and are sufficient to destabilize important attributes of the resource.

The impact categories evaluated in this chapter are the same as those used in the Generic Environmental Impact Statement for License Renewal of Nuclear Plants (GEIS), NUREG-1437, Volumes 1 and 2 (NRC 1996; 1999)[(a)], with the additional impact categories of environmental justice and transportation.

8.1 No-Action Alternative

NRC's regulations implementing the National Environmental Policy Act (NEPA) specify that the no-action alternative be discussed in an NRC environmental impact statement (EIS, see 10 CFR Part 51, Subpart A, Appendix A[4]). For license renewal, the no-action alternative refers to a scenario in which the NRC would not renew the OLs for Surry Power Station, Units 1 and 2, and the Virginia Electric and Power Company (VEPCo) would then decommission

(a) The GEIS was originally issued in 1996. Addendum 1 to the GEIS was issued in 1999. Hereafter, all references to the "GEIS" include the GEIS and its Addendum 1.

Units 1 and 2, when plant operations cease. Replacement of Units 1 and 2 electricity generation capacity would be met by (1) demand-side management and energy conservation, (2) power purchased from other electricity providers, (3) generating alternatives other than Units 1 and 2, or (4) some combination of these options. The environmental impacts associated with alternative generation technologies are discussed in Section 8.2.

VEPCo will be required to comply with NRC decommissioning requirements whether or not the OLs are renewed. If the Units 1 and 2 OLs are renewed, decommissioning activities may be postponed for up to an additional 20 years. If the OLs are not renewed, VEPCo would conduct decommissioning activities according to the requirements in 10 CFR 50.82. The GEIS (NRC 1996) and the *Final Generic Environmental Impact Statement on Decommissioning of Nuclear Facilities* (NRC 1988) provide descriptions of decommissioning activities.[(a)]

The environmental impacts associated with decommissioning under the no-action alternative would be bounded by the discussion of impacts in Chapter 7 of the GEIS, Chapter 7 of this Supplemental Environmental Impact Statement (SEIS), and the *Final Generic Environmental Impact Statement on Decommissioning of Nuclear Facilities* (NRC 1988). The impacts of decommissioning after 60 years of operation are not expected to be significantly different from those occurring after 40 years of operation.

The environmental impacts for the socioeconomic, historic and archaeological resources, and environmental justice impact categories are summarized in Table 8-1 and discussed in the following paragraphs. The no-action alternative would also have certain positive impacts in that adverse environmental impacts associated with current operation of Surry Power Station, for example, solid waste impacts and impacts on aquatic life, would be eliminated.

Table 8-1. Summary of Environmental Impacts of the No-Action Alternative

Impact Category	Impact	Comment
Socioeconomic	LARGE	Decrease in employment, higher-paying jobs, and tax revenues
Historic and Archaeological Resources	SMALL to MODERATE	Land occupied by Units 1 and 2 would likely be retained by VEPCo
Environmental Justice	MODERATE to LARGE	Loss of employment opportunities and social programs

(a) The NRC staff is currently updating the GEIS on decommissioning nuclear facilities. A draft for comment was issued on November 9, 2001 (66 FR 56721) (NRC 2001b). The staff is currently finalizing the draft Supplement for publication as a final document.

- Socioeconomic: When Surry Units 1 and 2 cease operation, there will be a decrease in employment and tax revenues associated with the closure. Employment (primary and secondary) impacts would be concentrated in Surry, James City, and Isle of Wight Counties and the City of Newport News. Approximately 60 percent of the employees who work at Surry Units 1 and 2 live in Surry, James City, and Isle of Wight Counties or the City of Newport News. The remainder live in other nearby locations (VEPCo 2001).

  Most of the tax revenue losses resulting from closure of Surry Units 1 and 2 would occur in Surry County. In 2001, VEPCo paid $10.9 million in property taxes to Surry County for the nuclear and fossil generation units at the Surry Power Station, or about 70 percent of all property taxes collected by the county (VEPCo 2001). The majority of the $10.9 million was attributable to Surry Power Station, Units 1 and 2. The no-action alternative would result in the loss of the taxes attributable to Surry Units 1 and 2 as well as the loss of plant payrolls 20 years earlier than if the OLs were renewed. Loss of the property tax revenue would have a significant negative impact on the ability of Surry County to provide public services such as schools and road maintenance. There would also be an adverse impact on housing values and the local economy in Surry County and surrounding areas if Surry Units 1 and 2 were to cease operations.

  VEPCo employees working at Surry Units 1 and 2 currently contribute time and money toward community involvement, including schools, churches, charities, and other civic activities. It is likely that with a reduced presence in the community following decommissioning, community involvement efforts by VEPCo and its employees in the region would be less. The socioeconomic impacts of this alternative are considered LARGE.

- Historic and Archaeological Resources: The potential for future adverse impacts to known or unrecorded cultural resources at the Surry Power Station following decommissioning of Units 1 and 2 will depend on the future use of the land occupied by the two units. Following decommissioning, land occupied by Units 1 and 2 would likely be retained by VEPCo for other corporate purposes. Eventual sale or transfer of the land occupied by Units 1 and 2, however, could result in adverse impacts to cultural resources if the land-use pattern changes dramatically. Notwithstanding this possibility, the impacts of this alternative on historic and archaeological resources are considered SMALL to MODERATE.

- Environmental Justice for No-Action: Current operations at Surry Units 1 and 2 have no disproportionate impacts on the minority and low-income populations of Surry and surrounding counties, and no environmental pathways have been identified that would cause disproportionate impacts. Closure of Units 1 and 2 would result in decreased

employment opportunities and tax revenues in Surry County and surrounding counties with possible negative and disproportionate impacts on minority or low-income populations. Because the Surry Power Station is located in a relatively rural area, the environmental justice impacts under the no-action alternative are considered MODERATE to LARGE.

Impacts for all other impact categories would be SMALL, as shown in Table 9-1.

8.2 Alternative Energy Sources

This section discusses the environmental impacts associated with alternative sources of electric power to replace the power generated by Surry Units 1 and 2, assuming that the OLs for Units 1 and 2 are not renewed. The order of presentation of alternative energy sources in Section 8.2 does not imply which alternative would be most likely to occur or to have the least environmental impacts. The following generation alternatives are considered in detail:

- coal-fired generation at the Surry Power Station site and at an alternate greenfield[(a)] site (Section 8.2.1)

- natural gas-fired generation at the Surry Power Station site and at an alternate greenfield site (Section 8.2.2)

- nuclear generation at the Surry Power Station site and at an alternate greenfield site (Section 8.2.3).

The alternative of purchasing power from other sources to replace power generated at Surry Units 1 and 2 is discussed in Section 8.2.4. Other power generation alternatives and conservation alternatives considered by the staff and found not to be reasonable replacements for Units 1 and 2 are discussed in Section 8.2.5. Section 8.2.6 discusses the environmental impacts of a combination of generation and conservation alternatives.

Each year, the Energy Information Administration (EIA), a component of the U.S. Department of Energy (DOE), issues an Annual Energy Outlook. In the *Annual Energy Outlook 2002* issued in December 2001 (DOE/EIA 2001a), EIA projects that combined-cycle or combustion turbine technology fueled by natural gas is likely to account for approximately 88 percent of new electric generating capacity between the years 2000 and 2020. Both technologies are designed primarily to supply peak and intermediate capacity, but combined-cycle technology can also be

(a) A greenfield site is assumed to be an undeveloped site with no previous construction.

used to meet baseload[a] requirements. Coal-fired plants are projected by EIA to account for approximately 9 percent of new capacity during this period. Coal-fired plants are generally used to meet baseload requirements. Renewable energy sources, primarily wind, geothermal, and municipal solid waste units, are projected by EIA to account for the remaining 3 percent of capacity additions. EIA's projections are based on the assumption that providers of new generating capacity will seek to minimize cost while meeting applicable environmental requirements. Combined-cycle plants are projected by EIA to have the lowest generation cost in 2005 and 2020, followed by coal-fired plants and then wind generation (DOE/EIA 2001a).

EIA projects that oil-fired plants will account for very little of new generation capacity in the U.S. during the 2000 to 2020 time period because of higher fuel costs and lower efficiencies (DOE/EIA 2001a).

EIA also projects that new nuclear power plants will not account for any new generation capacity in the U.S. during the 2000 to 2020 time period because natural gas and coal-fired plants are projected to be more economical (DOE/EIA 2001a). In spite of this projection, a new nuclear plant alternative for replacing power generated by Surry Units 1 and 2 is considered in Section 8.2.3. Since 1997, the NRC has certified three new standard designs for nuclear power plants under the procedures in 10 CFR Part 52, Subpart B: the U.S. Advanced Boiling Water Reactor (10 CFR Part 52, Appendix A), the System 80+ Design (10 CFR Part 52, Appendix B), and the AP600 Design (10 CFR Part 52, Appendix C). The submission to the NRC of these three applications for certification indicates continuing interest in the possibility of licensing new nuclear power plants. NRC has recently established a New Reactor Licensing Program Organization to prepare for and manage future reactor and site licensing applications (NRC 2001a).

Surry Units 1 and 2 have a combined average net capacity of 1602 megawatts electric (MW[e]). For the coal and natural gas alternatives, VEPCo's Environmental Report (ER) assumes three standard 508-MW(e) units[b] as potential replacements for Units 1 and 2 (VEPCo 2001). The staff used this assumption in their evaluation, although it results in some environmental impacts that are roughly 5 percent lower than if full replacement capacity were constructed. VEPCo's reasoning is that although customized unit sizes can be built, use of standardized sizes is more

(a) A baseload plant normally operates to supply all or part of the minimum continuous load of a system and consequently produces electricity at an essentially constant rate. Nuclear power plants are commonly used for baseload generation, i.e., these units generally run near full load.

(b) Each of the coal-fired units would have a rating of 538 gross MW and 508 net MW. Each of the gas-fired units would have a rating of 528 gross MW and 508 net MW. The difference between "gross" and "net" is the electricity consumed onsite.

economical. Moreover, using four 508-MW(e) units for the analysis would overestimate environmental impacts and tend to make the fossil alternatives less attractive.

8.2.1 Coal-Fired Generation

The coal-fired alternative is analyzed for both the Surry Power Station site and an alternate greenfield site. As discussed in Section 8.2, the staff assumed construction of three 508-MW(e) units.

The VEPCo ER assumes that coal and lime or limestone for a coal-fired plant sited at the Surry Power Station would be delivered by barge to the existing receiving dock (VEPCo 2001). Lime[(a)] (or limestone) is used in the scrubbing process for control of sulfur dioxide (SO_2) emissions. Rail delivery would be the most likely option for delivering coal and lime/limestone to an alternate inland site for the coal-fired plant. Barge delivery of coal and lime/limestone is potentially feasible for a coastal site. A coal slurry pipeline is also a technically feasible delivery option; however, the associated cost and environmental impacts make a slurry pipeline an unlikely transportation alternative. Construction at an alternate site could necessitate the construction of a new transmission line to connect to existing lines and a rail spur to the plant site.

The coal-fired plant would consume approximately 4.4 million MT (4.9 million tons) per year of pulverized bituminous coal with an ash content by weight of approximately 10.7 percent (VEPCo 2001). The ER assumes a heat rate[(b)] of 3 J fuel/J electricity (10,200 Btu/kWh) and a capacity factor[(c)] of 0.85 (VEPCo 2001). After combustion, 99.9 percent of the ash (approximately 474,000 MT/yr [522,000 tons/yr]) would be collected and disposed of at the plant site. In addition, approximately 221,000 MT/yr (244,000 tons/yr) of scrubber sludge would be disposed of at the plant site based on annual lime usage of approximately 76,000 MT (84,000 tons) (VEPCo 2001).

Unless otherwise indicated, the assumptions and numerical values used in Section 8.2.1 are from the VEPCo ER (VEPCo 2001). The staff reviewed this information and compared it to

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(a) In a typical wet scrubber, lime (calcium hydroxide) or limestone (calcium carbonate) is injected as a slurry into the hot effluent combustion gases to remove entrained sulfur dioxide. The lime-based scrubbing solution reacts with sulfur dioxide to form calcium sulfite, which precipitates out and is removed in sludge form.

(b) Heat rate is a measure of generating-station thermal efficiency. In English units, it is generally expressed in British thermal units (Btu) per net kilowatt-hour (kWh). It is computed by dividing the total Btu content of fuel burned for electric generation by the resulting net kWh generation.

(c) The capacity factor is the ratio of electricity generated, for the period of time considered, to the energy that could have been generated at continuous full-power operation during the same period.

environmental impact information in the GEIS. Although the OL renewal period is only 20 years, the impact of operating the coal-fired alternative for 40 years is considered (as a reasonable projection of the operating life of a coal-fired plant).

8.2.1.1 Once-Through Cooling System

For purposes of this SEIS, the staff assumed that a coal-fired plant located at the Surry Power Station would use the existing once-through system as a source of cooling. An alternate greenfield site could use either a closed-cycle or a once-through cooling system.

The overall impacts of the coal-fired generating system are discussed in the following sections and summarized in Table 8-2. The extent of impacts at an alternate site would depend on the location of the particular site selected.

- **Land Use**

  The existing facilities and infrastructure at the Surry Power Station site would be used to the extent practicable, limiting the amount of new construction that would be required. Specifically, the staff assumed that the coal-fired replacement plant alternative would use the existing once-through cooling system, switchyard, offices, and transmission line rights-of-way. Some additional land beyond the current Surry Power Station site boundary may be needed to construct a new coal-fired plant while the existing nuclear Units 1 and 2 continue to operate.

  The coal-fired generation alternative would necessitate converting most of the unused land at the Surry Power Station to industrial use for the plant, coal storage, and landfill disposal of ash, spent selective catalytic reduction catalyst (used for control of nitrogen oxide emissions), and scrubber sludge. VEPCo estimates that ash and scrubber waste disposal over a 40-year plant life would require approximately 172 ha (425 ac) (VEPCo 2001). Additional land-use changes would occur offsite in an undetermined coal-mining area to supply coal for the plant. The GEIS estimated that approximately 8900 ha (22,000 ac) would be affected for mining the coal and disposing of the waste to support a 1000-MW(e) coal plant during its operational life (NRC 1996). A replacement coal-fired plant for Surry Units 1 and 2 would be 1524 MW(e) and would affect proportionately more land. Partially offsetting this offsite land use would be the elimination of the need for uranium mining to supply fuel for Surry Units 1 and 2. The GEIS states that approximately 400 ha (1000 ac) would be affected for mining the uranium and processing it during the operating life of a 1000-MW(e) nuclear power plant (NRC 1996).

Table 8-2. Summary of Environmental Impacts of Coal-Fired Generation at Surry Power Station and an Alternate Greenfield Site Using Once-Through Cooling

	Surry Power Station Site		Alternate Greenfield Site	
Impact Category	**Impact**	**Comments**	**Impact**	**Comments**
Land Use	MODERATE	Uses most of unused portion of Surry Power Station site for plant, infrastructure, and waste disposal. Additional offsite land may also be needed. Additional offsite land impacts for coal and limestone mining.	MODERATE to LARGE	Uses up to 700 ha (1700 ac) for plant and infrastructure; additional land impacts for coal and limestone mining; possible impacts for transmission line and rail spur.
Ecology	MODERATE to LARGE	Uses undeveloped areas at Surry Power Station plus some offsite land. Potential habitat loss and fragmentation and reduced productivity and biological diversity.	MODERATE to LARGE	Impact depends on location and ecology of the site, surface-water body used for intake and discharge, and transmission line route; potential habitat loss and fragmentation; reduced productivity and biological diversity.
Water Use and Quality	SMALL	Uses existing once-through cooling system	SMALL to MODERATE	Impact will depend on the volume of water withdrawn and discharged and the characteristics of the surface-water body.
Air Quality	MODERATE	Sulfur oxides • 4126 MT/yr (4548 tons/yr) Nitrogen oxides • 1075 MT/yr (1185 tons/yr) Particulates • 237 MT/yr (261 tons/yr) of total suspended particulates which would include 54 MT/yr (60 tons/yr) of PM_{10} Carbon monoxide • 1108 MT/yr (1221 tons/yr) Small amounts of mercury and other hazardous air pollutants and naturally occurring radioactive materials – mainly uranium and thorium	MODERATE	Potentially same impacts as the Surry Power Station site, although pollution control standards may vary.

Table 8-2. (contd)

	Surry Power Station Site		Alternate Greenfield Site	
Impact Category	**Impact**	**Comments**	**Impact**	**Comments**
Waste	MODERATE	Total waste volume would be approximately 700,000 MT/yr (770,000 tons/yr) of ash, spent catalyst, and scrubber sludge requiring approximately 172 ha (425 ac) for disposal during the 40-year life of the plant.	MODERATE	Same impacts as Surry Power Station site; waste disposal constraints may vary.
Human Health	SMALL	Impacts are uncertain, but considered SMALL in the absence of more quantitative data.	SMALL	Same impact as Surry Power Station site.
Socioeconomics	SMALL to LARGE	During construction, impacts would be MODERATE to LARGE. Up to 2500 workers during the peak of the 5-year construction period, followed by reduction from current Surry Units 1 and 2 workforce of 990 to 200. Tax base preserved. Impacts during operation would be SMALL. Transportation impacts associated with construction workers could be MODERATE to LARGE. For barge transportation of coal and lime/limestone, the impact is considered SMALL.	SMALL to LARGE	Construction impacts depend on location, but could be LARGE if plant is located in a rural area. Surry County would experience loss of Units 1 and 2 tax base and employment with potentially LARGE impacts. Impacts during operation would be SMALL. Transportation impacts associated with construction workers could be MODERATE to LARGE. For rail transportation of coal and lime/limestone, the impact is considered MODERATE to LARGE. For barge transportation, the impact is considered SMALL.

Table 8-2. (contd)

	Surry Power Station Site		Alternate Greenfield Site	
Impact Category	**Impact**	**Comments**	**Impact**	**Comments**
Aesthetics	MODERATE to LARGE	MODERATE to LARGE aesthetic impact. Exhaust stacks will be visible from the Hog Island Wildlife Management Area, the James River, Chippokes Plantation State Park, and Colonial National Historical Park. Barge transportation of coal and lime/limestone would have a SMALL aesthetic impact. Noise impact would be SMALL to MODERATE.	MODERATE to LARGE	Impact would depend on the site selected and the surrounding land features. If needed, a new transmission line or rail spur would add to the aesthetic impact. Rail transportation of coal and lime/limestone would have a MODERATE aesthetic impact. Barge transportation of coal and lime/limestone would have a SMALL aesthetic impact. Noise impact would be SMALL to MODERATE.
Historic and Archeological Resources	SMALL	Some construction would affect previously developed parts of Surry Power Station site; cultural resource inventory should minimize any impacts on undeveloped lands.	SMALL	Alternate location would necessitate cultural resource studies.
Environmental Justice	MODERATE	Impacts on minority and low-income communities should be similar to those experienced by the population as a whole. Some impacts on housing may occur during construction; loss of 790 operating jobs at Surry Power Station could reduce employment prospects for minority and low-income populations.	MODERATE to LARGE	Impacts at alternate site vary depending on population distribution and makeup at site. Surry County would lose significant revenue, which could have MODERATE to LARGE impacts on minority and low-income populations.

The impact of a coal-fired generating unit on land use at the Surry Power Station site is best characterized as MODERATE. The impact would definitely be greater than the OL renewal alternative.

In the GEIS, NRC staff estimated that a 1000-MW(e) coal-fired plant would require approximately 700 ha (1700 ac) (NRC 1996). It is likely that this acreage would be sufficient for a 1524-MW(e) coal-fired generation alternative at an alternate greenfield site. Additional land could be needed for a transmission line and for a rail spur to the plant site. Depending

particularly on transmission line and rail line routing requirements, this alternative would result in MODERATE to LARGE land-use impacts.

- **Ecology**

  Locating a coal-fired plant at the Surry Power Station site would alter ecological resources because of the need to convert most of the currently unused land at the Station to industrial use for the plant, coal storage, and ash and scrubber sludge disposal. However, some of this land would have been previously disturbed.

  Siting a coal-fired plant at the Surry Power Station would have a MODERATE to LARGE ecological impact that would be greater than renewal of the Units 1 and 2 OLs.

  At an alternate site, the coal-fired generation alternative would introduce construction impacts and new incremental operational impacts. Even assuming siting at a previously disturbed area, the impacts would alter the ecology. Impacts could include wildlife habitat loss, reduced productivity, habitat fragmentation, and a local reduction in biological diversity. Use of cooling makeup water from a nearby surface-water body could have adverse aquatic resource impacts. If needed, construction and maintenance of a transmission line and a rail spur would have ecological impacts. Overall, the ecological impacts at an alternate site would be MODERATE to LARGE.

- **Water Use and Quality**

  The coal-fired generation alternative at the Surry Power Station site is assumed to use the existing once-through cooling system, which would minimize incremental water use and quality impacts. Surface-water impacts are expected to remain SMALL; the impacts would be sufficiently minor that they would not noticeably alter any important attribute of the resource.

  The staff assumed that a coal-fired plant located at the Surry Power Station would obtain potable, process, and fire-protection water from the series of groundwater wells that currently supply Units 1 and 2 (see Section 2.2.2). Use of groundwater for a coal-fired plant at an alternate site is a possibility. Groundwater withdrawal at an alternate site would likely require a permit.

  Some erosion and sedimentation would likely occur during construction (NRC 1996).

For a coal-fired plant located at an alternate site, the impact on the surface water would depend on the discharge volume and the characteristics of the receiving body of water. Intake from and discharge to any surface body of water would be regulated by the Commonwealth of Virginia or another state. The impacts would be SMALL to MODERATE.

- **Air Quality**

The air-quality impacts of coal-fired generation vary considerably from those of nuclear generation due to emissions of sulfur oxides (SO_x), nitrogen oxides (NO_x), particulates, carbon monoxide, hazardous air pollutants such as mercury, and naturally occurring radioactive materials.

Surry County is in the State Capital Intrastate Air Quality Control Region (40 CFR 81.145). Surry County is in compliance with the national ambient air quality standards for particulate matter, carbon monoxide, nitrogen dioxide, lead, sulfur dioxide (SO_2), and ozone (40 CFR 81.347).

A new coal-fired generating plant located at the Surry Power Station would likely need a prevention of significant deterioration (PSD) permit and an operating permit under the Clean Air Act. The plant would need to comply with the performance standards for new plants set forth in 40 CFR Part 60, Subpart Da. The standards establish limits for particulate matter and opacity (40 CFR 60.42a), SO_2 (40 CFR 60.43a), and NO_x (40 CFR 60.44a).

The U.S. Environmental Protection Agency (EPA) has various regulatory requirements for visibility protection in 40 CFR Part 51, Subpart P, including a specific requirement for review of any new major stationary source in an area designated as attainment or unclassified under the Clean Air Act. Surry County is classified as attainment or unclassified for criteria pollutants.[(a)]

Section 169A of the Clean Air Act (42 USC 7401) establishes a national goal of preventing future and remedying existing impairment of visibility in mandatory Class I Federal areas when impairment results from man-made air pollution. EPA issued a new regional haze rule in 1999 (64 FR 35714; July 1,1999 [EPA 1999]). The rule specifies that for each mandatory Class I Federal area located within a state, the state must establish goals that provide for reasonable progress towards achieving natural visibility conditions. The reasonable progress goals must provide for an improvement in visibility for the most-impaired days over

(a) Existing criteria pollutants under the Clean Air Act are ozone, carbon monoxide, particulates, sulfur dioxide, lead, and nitrogen oxide. Ambient air standards for criteria pollutants are set out in 40 CFR Part 50.

the period of the implementation plan and ensure no degradation in visibility for the least impaired days over the same period (40 CFR 51.308[d][1]). If a coal-fired plant were located close to a mandatory Class I area, additional air pollution control requirements could be imposed. However, the closest mandatory Class I Federal areas to Surry Power Station are the Swanquarter Wilderness in eastern North Carolina located approximately 200 km (125 mi) southeast of Surry Power Station, Shenandoah National Park located approximately 225 km (140 mi) northwest of Surry Power Station, and the James River Face Wilderness located approximately 240 km (150 mi) west of Surry Power Station.

In 1998, EPA issued a rule requiring 22 eastern states, including Virginia, to revise their state implementation plans to reduce NO_x emissions (63 FR 49442, EPA 1998). Nitrogen-oxide emissions contribute to violations of the national ambient air quality standard for ozone. The total amount of nitrogen oxides that can be emitted by each of the 22 states in the year 2007 ozone season (May 1 - September 30) is set out at 40 CFR 51.121(e). For Virginia, the amount is 163,470 MT (180,195 tons). Any new coal-fired plant sited in Virginia would be subject to this limitation.

Impacts for particular pollutants are as follows:

Sulfur oxides emissions. VEPCo states in its ER that an alternative coal-fired plant located at the Surry Power Station site would use wet scrubber technology utilizing lime/limestone for flue gas desulfurization (VEPCo 2001).

A new coal-fired power plant would be subject to the requirements in Title IV of the Clean Air Act. Title IV was enacted to reduce emissions of SO_2 and NO_x, the two principal precursors of acid rain, by restricting emissions of these pollutants from power plants. Title IV caps aggregate annual power plant SO_2 emissions and imposes controls on SO_2 emissions through a system of marketable allowances. EPA issues one allowance for each ton of SO_2 that a unit is allowed to emit. New units do not receive allowances, but are required to have allowances to cover their SO_2 emissions. Owners of new units must, therefore, acquire allowances from owners of other power plants by purchase or reduce SO_2 emissions at other power plants they own. Allowances can be banked for use in future years. Thus, a new coal-fired power plant would not add to net regional SO_2 emissions, although it might do so locally. Regardless, SO_2 emissions would be greater for the coal alternative than the OL renewal alternative.
VEPCo estimates that by using the best technology to minimize SO_x emissions, the total annual stack emissions would be approximately 4130 MT (4548 tons) of SO_x (VEPCo 2001).

Nitrogen oxides emissions. Section 407 of the Clean Air Act establishes technology-based emission limitations for NO_x emissions. The market-based allowance system used for SO_2 emissions is not used for NO_x emissions. A new coal-fired power plant would be subject to

the new source performance standards for such plants in 40 CFR 60.44a(d)(1). This regulation, issued on September 16, 1998 (EPA 1998), limits the discharge of any gases that contain nitrogen oxides (expressed as NO_2) in excess of 200 ng/J of gross energy output (1.6 lb/MWh), based on a 30-day rolling average.

VEPCo estimates that by using NO_x burners with overfire air and selective catalytic reduction, the total annual NO_x emissions for a new coal-fired power plant would be approximately 1075 MT (1185 tons) (VEPCo 2001). This level of NO_x emissions would be greater than the OL renewal alternative.

Particulates emissions. VEPCo estimates that the total annual stack emissions would include 237 MT (261 tons) of filterable total suspended particulates (particulates that range in size from less than 0.1 micrometer up to approximately 45 micrometers). The 237 MT would include 54 MT (60 tons) of PM_{10} (particulate matter having an aerodynamic diameter less than or equal to 10 micrometers). Fabric filters or electrostatic precipitators would be used for control. In addition, coal-handling equipment would introduce fugitive particulate emissions. Particulate emissions would be greater under the coal alternative than the OL renewal alternative.

During the construction of a coal-fired plant, fugitive dust would be generated. In addition, exhaust emissions would come from vehicles and motorized equipment used during the construction process.

Carbon monoxide emissions. VEPCo estimates that the total carbon monoxide emissions would be approximately 1110 MT (1221 tons) per year (VEPCo 2001). This level of emissions is greater than the OL renewal alternative.

Hazardous air pollutants emissions, including mercury. In December 2000, EPA issued regulatory findings on emissions of hazardous air pollutants from electric utility steam generating units (65 FR 79825, EPA 2000b). EPA determined that coal- and oil-fired electric utility steam-generating units are significant emitters of hazardous air pollutants. Coal-fired power plants were found by EPA to emit arsenic, beryllium, cadmium, chromium, dioxins, hydrogen chloride, hydrogen fluoride, lead, manganese, and mercury (EPA 2000b). EPA concluded that mercury is the hazardous air pollutant of greatest concern. EPA found that (1) there is a link between coal consumption and mercury emissions, (2) electric utility steam-generating units are the largest domestic source of mercury emissions, and (3) certain segments of the U.S. population (e.g., developing fetuses and subsistence fish-eating populations) are believed to be at potential risk of adverse health effects due to mercury exposures resulting from consumption of contaminated fish (EPA 2000b). Accordingly, EPA added coal- and oil-fired electric utility steam-generating units to the list of

source categories under Section 112(c) of the Clean Air Act for which emission standards for hazardous air pollutants will be issued (EPA 2000b).

Uranium and thorium emissions. Coal contains uranium and thorium. Uranium concentrations are generally in the range of 1 to 10 parts per million. Thorium concentrations are generally about 2.5 times greater than uranium concentrations (Gabbard 1993). One estimate is that a typical coal-fired plant released roughly 4.7 MT (5.2 tons) of uranium and 11.6 MT (12.8 tons) of thorium in 1982 (Gabbard 1993). The population dose equivalent from the uranium and thorium releases and daughter products produced by the decay of these isotopes has been calculated to be significantly higher than that from nuclear power plants (Gabbard 1993).

A coal-fired plant would also have unregulated carbon-dioxide emissions that could contribute to global warming.

Summary. The GEIS analysis did not quantify emissions from coal-fired power plants, but implied that air impacts would be substantial. The GEIS also mentioned global warming from unregulated carbon-dioxide emissions and acid rain from SO_x and NO_x emissions as potential impacts (NRC 1996). Adverse human health effects such as cancer and emphysema have been associated with the products of coal combustion. The appropriate characterization of air impacts from coal-fired generation would be MODERATE. The impacts would be clearly noticeable, but would not destabilize air quality.

Siting a coal-fired generation plant at a site other than Surry Power Station would not significantly change air-quality impacts, although it could result in installing more or less stringent pollution-control equipment to meet applicable local requirements. Therefore, the impacts would be MODERATE.

- **Waste**

Coal combustion generates waste in the form of ash, and equipment for controlling air pollution generates spent selective catalytic reduction (SCR) catalyst, additional ash, and scrubber sludge. Three 508-MW(e) coal-fired units would generate approximately 695,000 MT (766,060 tons) of this waste annually. The waste would be disposed of onsite, accounting for approximately 172 ha (425 ac) of land area over the 40-year plant life. Waste impacts to groundwater and surface water could extend beyond the operating life of the plant if leachate and runoff from the waste storage area occurs. Disposal of the waste could noticeably affect land use and groundwater quality, but with appropriate management and monitoring, it would not destabilize any resources. After closure of the waste site and

revegetation, the land could be available for other uses. Construction-related debris would be generated during construction activities.

In May 2000, EPA issued a Notice of Regulatory Determination on Wastes from the Combustion of Fossil Fuels (65 FR 32214, EPA 2000a). EPA concluded that some form of national regulation is warranted to address coal combustion waste products because (1) the composition of these wastes could present danger to human health and the environment under certain conditions, (2) EPA has identified 11 documented cases of proven damage to human health and the environment by improper management of these wastes in landfills and surface impoundments, (3) present disposal practices are such that, in 1995, these wastes were being managed in 40 to 70 percent of landfills and surface impoundments without reasonable controls in place, particularly in the area of groundwater monitoring, and (4) EPA identified gaps in state oversight of coal combustion wastes. Accordingly, EPA announced its intention to issue regulations for disposal of coal combustion waste under Subtitle D of the Resource Conservation and Recovery Act (RCRA).

For all of the preceding reasons, the appropriate characterization of impacts from waste generated from burning coal is MODERATE; the impacts would be clearly noticeable, but would not destabilize any important resource.

Siting the facility at a site other than the Surry Power Station would not alter waste generation, although other sites might have more constraints on disposal locations. Therefore, the impacts would be MODERATE.

- **Human Health**

Coal-fired power generation introduces worker risks from coal and limestone mining, worker and public risks from coal and lime/limestone transportation, worker and public risks from disposal of coal combustion wastes, and public risks from inhalation of stack emissions. Emission impacts can be widespread and health risks difficult to quantify. The coal alternative also introduces the risk of coal pile fires and attendant inhalation risks.

In the GEIS, the staff stated that there could be human health impacts (cancer and emphysema) from inhalation of toxins and particulates from a coal-fired plant, but did not identify the significance of these impacts (NRC 1996). In addition, the discharges of uranium and thorium from coal-fired plants can potentially produce radiological doses in excess of those arising from nuclear power plant operations (Gabbard 1993).

Regulatory agencies, including EPA and State agencies, set air-emission standards and requirements based on human health impacts. These agencies also impose site-specific

emission limits as needed to protect human health. As discussed previously, EPA has recently concluded that certain segments of the U.S. population (e.g., developing fetuses and subsistence fish-eating populations) are believed to be at potential risk of adverse health effects due to mercury exposures from sources such as coal-fired power plants. However, in the absence of more quantitative data, human health impacts from radiological doses and inhaling toxins and particulates generated by burning coal are characterized as SMALL.

- **Socioeconomics**

  Construction of the coal-fired alternative would take approximately 5 years. The staff assumed that construction would take place while Surry Units 1 and 2 continue operation and would be completed by the time Units 1 and 2 permanently cease operations. The workforce would be expected to vary between 1200 and 2500 workers during the 5-year construction period (NRC 1996). These workers would be in addition to the approximately 990 workers employed at Units 1 and 2. During construction of the new coal-fired plant, communities near the Surry Power Station would experience demands on housing and public services that could have MODERATE to LARGE impacts. These impacts would be tempered by construction workers commuting to the site from more distant cities such as Hampton, Norfolk, Chesapeake, Portsmouth, and Virginia Beach. After construction, the nearby communities would be impacted by the loss of the construction jobs. VEPCo estimates that the completed coal plant would employ approximately 200 workers (VEPCo 2001).

  If the coal-fired replacement plant were constructed at the Surry Power Station site and Units 1 and 2 were decommissioned, there would be a loss of approximately 790 permanent high-paying jobs (from 990 for the two nuclear units down to 200 for the coal-fired plant), with a commensurate reduction in demand on socioeconomic resources and contribution to the regional economy. The coal-fired plants would provide a new tax base to offset the loss of tax base associated with decommissioning of the nuclear units. For all of these reasons, the appropriate characterization of nontransportation socioeconomic impacts for an operating coal-fired plant constructed at the Surry Power Station site would be MODERATE. The socioeconomic impacts would be noticeable, but would be unlikely to destabilize the area.

  During the 5-year construction period of replacement coal-fired units, up to 2500 construction workers would be working at the site in addition to the 990 workers at Units 1 and 2. The addition of these workers could place significant traffic loads on existing highways near the Surry Power Station. Such impacts would be MODERATE to LARGE.

For transportation related to commuting of plant-operating personnel, the impacts are considered SMALL. The maximum number of plant-operating personnel would be approximately 200. The current Surry Units 1 and 2 workforce is approximately 990. Therefore, traffic impacts associated with plant personnel commuting to a coal-fired plant would be expected to be SMALL compared to the current impacts from Unit 1 and 2 operations.

Barge delivery of coal and lime/limestone to the Surry Power Station would likely have SMALL socioeconomic impacts.

Construction of a replacement coal-fired power plant at an alternate greenfield site would relocate some socioeconomic impacts, but would not eliminate them. The communities around Surry Power Station would experience the impact of Surry Units 1 and 2 operational job loss and Surry County would lose a significant tax base. These losses would have potentially LARGE socioeconomic impacts. Communities around the new site would have to absorb the impacts of a large, temporary workforce (up to 2500 workers at the peak of construction) and a permanent workforce of approximately 200 workers. In the GEIS, the staff stated that socioeconomic impacts at a rural site would be larger than at an urban site because more of the peak construction workforce would need to move to the area to work (NRC 1996). Alternate sites would need to be analyzed on a case-by-case basis. Socioeconomic impacts at a rural site could be LARGE. Transportation-related impacts associated with commuting construction workers at an alternate site are site-dependent, but could be MODERATE to LARGE. Transportation impacts related to commuting of plant-operating personnel would also be site-dependent, but can be characterized as SMALL to MODERATE.

At an alternate greenfield site, coal and lime/limestone would likely be delivered by rail, although barge delivery is feasible for a coastal location. Transportation impacts would depend upon the site location. For the rail delivery option, coal would likely be delivered by rail trains of approximately 115 cars each. Each open-top rail car holds about 90 MT (100 tons) of coal. Additional rail cars would be needed for lime/limestone delivery. In all, approximately 440 trains per year would deliver the coal and lime/limestone for the three units. An average of roughly 17 train trips per week on the rail spur would be needed because for each full train delivery, there would be an empty return train. On several days per week, there could be three trains per day using the rail spur to the alternate site. Socioeconomic impacts associated with rail transportation, such as delays at rail crossings, would likely be MODERATE to LARGE. Barge delivery of coal and lime/limestone would likely have SMALL socioeconomic impacts.

- **Aesthetics**

  The three coal-fired power plant units could be as much as 60 m (200 ft) tall and be visible in daylight hours over many miles. The three exhaust stacks would be as much as 185 m (600 ft) high (VEPCo 2001). Given the low elevation at the site and of the surrounding land, the stacks would likely be highly visible in daylight hours for distances up to 16 km (10 mi). The stacks would be visible from the Hog Island Wildlife Management Area, the James River, Chippokes Plantation State Park, and Colonial National Historical Park, particularly the historic Jamestown portion of the park. The plant units and associated stacks would also be visible at night because of outside lighting. Visual impacts of a new coal-fired plant could be mitigated by landscaping and color selection for buildings that is consistent with the environment. Visual impact at night could be mitigated by reduced use of lighting and appropriate use of shielding.

  The aesthetic impact of the replacement coal-fired units on visitors to the historic Jamestown portion of Colonial National Historical Park would be particularly significant. Given the environmental sensitivity of the park and the associated expectations of visitors to national parks, the addition of the coal-fired units and the associated exhaust stacks would likely have a MODERATE to LARGE aesthetic impact.

  Coal-fired generation would introduce mechanical sources of noise that would be audible offsite. Sources contributing to total noise produced by plant operation are classified as continuous or intermittent. Continuous sources include the mechanical equipment associated with normal plant operations. Intermittent sources include the equipment related to coal handling, solid-waste disposal, transportation related to coal and lime/limestone delivery, use of outside loudspeakers, and the commuting of plant employees. The incremental noise impacts of a coal-fired plant compared to existing Surry Units 1 and 2 operations are considered to be SMALL to MODERATE given the rural location of the plant.

  Noise associated with barge transportation of coal and lime/limestone would be SMALL.

  At an alternate greenfield site, there would be an aesthetic impact from the buildings and exhaust stacks. There would be an aesthetic impact that could be LARGE if construction of a new transmission line and/or rail spur is needed. Noise impacts associated with rail delivery of coal and lime/limestone would be most significant for residents living in the vicinity of the facility and along the rail route. Although noise from passing trains significantly raises noise levels near the rail corridor, the short duration of the noise reduces the impact. Nevertheless, given the frequency of train transport and the fact that many people are likely to be within hearing distance of the rail route, the impact of noise on residents in the vicinity of the facility and the rail line is considered MODERATE. Noise and

light from the plant would be detectable offsite. Aesthetic impacts at the plant site would be mitigated if the plant were located in an industrial area adjacent to other power plants. Overall, the aesthetic impacts associated with locating at an alternate site can be categorized as MODERATE to LARGE.

- **Historic and Archaeological Resources**

  At the Surry Power Station site or an alternate site, a cultural resource inventory would likely be needed for any onsite property that has not been previously surveyed. Other lands, if any, that are acquired to support the plant would also likely need an inventory of field cultural resources, identification and recording of existing historic and archaeological resources, and possible mitigation of adverse effects from subsequent ground-disturbing actions related to physical expansion of the plant site.

  Before construction at Surry Power Station or an alternate greenfield site, studies would likely be needed to identify, evaluate, and address mitigation of the potential impacts of new plant construction on cultural resources. The studies would likely be needed for all areas of potential disturbance at the proposed plant site and along associated corridors where new construction would occur (e.g., roads, transmission corridors, rail lines, or other rights-of-way). Historic and archaeological resource impacts can generally be effectively managed and as such are considered SMALL.

- **Environmental Justice**

  No environmental pathways or locations have been identified that would result in disproportionately high and adverse environmental impacts on minority and low-income populations if a replacement coal-fired plant were built at the Surry Power Station site. Some impacts on housing availability and prices during construction might occur, and this could disproportionately affect minority and low-income populations. Closure of Surry Units 1 and 2 would result in a decrease in employment of approximately 790 operating employees. Resulting economic conditions could reduce employment prospects for minority or low-income populations. Overall, impacts are expected to be MODERATE.

  Impacts at other sites would depend upon the site chosen and the nearby population distribution. If a replacement coal-fired plant were constructed at an alternate site, Surry County would experience a significant loss of property tax revenue, which would affect the County's ability to provide services and programs. Impacts to minority and low-income populations in Surry County could be MODERATE to LARGE.

8.2.1.2 Closed-Cycle Cooling System

The environmental impacts of constructing a coal-fired generation system at an alternate greenfield site using closed-cycle cooling with cooling towers are essentially the same as the impacts for a coal-fired plant using the once-through system. However, there are some environmental differences between the closed-cycle and once-through cooling systems. Table 8-3 summarizes the incremental differences.

8.2.2 Natural Gas-Fired Generation

The environmental impacts of the natural gas-fired alternative are examined in this section for both the Surry Power Station site and an alternate greenfield site. For the Surry Power Station site, the staff assumed that the plant would use the existing once-through cooling system.

The Surry Power Station site is currently served by natural gas pipelines from Newport News that pass under the James River (VEPCo 2001). The pipelines enter the VEPCo property near the cooling water intake structure. VEPCo assumes that construction of replacement natural gas-fired units at the Surry Power Station site would require a new dedicated high-pressure 61-cm (24-in.) diameter pipeline from Danville, Virginia (VEPCo 2001). Danville is approximately 238 km (148 mi) from the Surry Power Station. VEPCo also states in its ER that in the winter, when demand for natural gas is high, it may become necessary for a replacement natural gas- fired plant to operate on fuel oil due to a lack of gas supply (VEPCo 2001). Operation with oil would result in more stack emissions.

If a new natural gas-fired plant were built elsewhere to replace Surry Units 1 and 2, a new transmission line could need to be constructed to connect to existing lines. In addition, construction or upgrade of a natural gas pipeline from the plant to a supply point where a firm supply of gas would be available could be needed. One potential source of natural gas is liquefied natural gas (LNG) imported to either the Cove Point facility in Maryland or the Elba Island facility in Georgia. Both facilities are expected to be reactivated in 2002 (DOE/EIA 2001a). LNG imported to either facility would need to be vaporized and transported to the plant location via pipeline.

The staff assumed that a replacement natural gas-fired plant would use combined-cycle combustion turbines (VEPCo 2001). In a combined-cycle unit, hot combustion gases in a combustion turbine rotate the turbine to generate electricity. Waste combustion heat from the combustion turbine is routed through a heat-recovery boiler to make steam to generate additional electricity.

Table 8-3. Summary of Environmental Impacts of Coal-Fired Generation at an Alternate Greenfield Site with Closed-Cycle Cooling System Utilizing Cooling Towers

Impact Category	Change in Impacts from Once-Through Cooling System
Land Use	Requires 10-12 additional ha (25-30 ac) for cooling towers and associated infrastructure.
Ecology	Impact would depend on ecology at the site. Additional impact to terrestrial ecology from cooling tower drift. Reduced impact to aquatic ecology.
Surface Water Use and Quality	Discharge of cooling tower blowdown containing dissolved solids. Discharge would be regulated by the State. Decreased water withdrawal and less thermal load on receiving body of water. Consumptive use of water due to evaporation.
Groundwater Use and Quality	No change
Air Quality	No change
Waste	No change
Human Health	No change
Socioeconomics	No change
Aesthetics	Introduction of cooling towers and associated plumes. Natural draft towers could be up to 158 m (520 ft) high. Mechanical draft towers could be up to 30 m (100 ft) high and also have an associated noise impact.
Historic and Archaeological Resources	No change
Environmental Justice	No change

The following additional assumptions are made for the natural gas-fired plants (VEPCo 2001):

- three 508-MW(e) units, each consisting of two 168-MW combustion turbines and a 172-MW heat recovery boiler
- natural gas with an average heating value of 39 MJ/m^3 (1059 Btu/ft^3) as the primary fuel
- use of low-sulfur number 2 fuel oil as backup fuel
- heat rate of 2 J fuel/J electricity (6700 Btu/kWh)
- capacity factor of 0.85
- gas consumption of 2.11 billion m^3/yr (74.7 billion ft^3/yr).

Unless otherwise indicated, the assumptions and numerical values used in Section 8.2.2 are from the VEPCo ER. The staff reviewed this information and compared it to environmental impact information in the GEIS. Although the OL renewal period is only 20 years, the impact of operating the natural gas-fired alternative for 40 years is considered (as a reasonable projection of the operating life of a natural gas-fired plant).

8.2.2.1 Once-Through Cooling System

The overall impacts of the natural gas-generating system are discussed in the following sections and summarized in Table 8-4. The extent of impacts at an alternate greenfield site will depend on the location of the particular site selected.

- **Land Use**

  For siting at the Surry Power Station, existing facilities and infrastructure would be used to the extent practicable, limiting the amount of new construction that would be required. Specifically, the staff assumed that the natural gas-fired replacement plant alternative would use the existing once-through cooling system, switchyard, offices, and transmission line rights-of-way. For Surry Power Station, the staff assumed that approximately 14 ha (35 ac) would be needed for the plant and associated infrastructure. There would be an additional land use impact of up to approximately 1200 ha (3000 ac) for construction of a natural gas pipeline adjacent to existing previously disturbed pipeline easements (VEPCo 2001).

Table 8-4. Summary of Environmental Impacts of Natural Gas-Fired Generation at Surry Power Station and an Alternate Greenfield Site Using Once-Through Cooling

	Surry Power Station Site		Alternate Greenfield Site	
Impact Category	**Impact**	**Comments**	**Impact**	**Comments**
Land Use	MODERATE to LARGE	14 ha (35 ac) for powerblock, roads, and parking areas. Additional impact of up to approximately 1200 ha (3000 ac) for construction of an underground gas pipeline.	MODERATE to LARGE	45 ha (110 ac) for power-block, offices, roads, switchyard, and parking areas. Additional land possibly impacted for transmission line and/or natural gas pipeline.
Ecology	MODERATE to LARGE	Uses undeveloped areas at Surry Power Station plus land for a new gas pipeline.	MODERATE to LARGE	Impact depends on location and ecology of the site, surface water body used for intake and discharge, and possible transmission and pipeline routes; potential habitat loss and fragmentation; reduced productivity and biological diversity.
Water Use and Quality	SMALL	Uses existing once-through cooling system.	SMALL to MODERATE	Impact depends on volume of water withdrawal and discharge and characteristics of surface water body.
Air Quality	MODERATE	Sulfur oxides • 122 MT/yr (134 tons/yr) Nitrogen oxides • 459 MT/yr (506 tons/yr) Carbon monoxide • 602 MT/yr (664 tons/yr) PM_{10} particulates • 180 MT/yr (198 tons/yr) Some hazardous air pollutants	MODERATE	Same emissions as Surry Power Station site.
Waste	SMALL	The only significant waste would be spent SCR catalyst used for control of NO_x emissions.	SMALL	The only significant waste would be spent SCR catalyst used for control of NO_x emissions.
Human Health	SMALL	Impacts considered to be minor.	SMALL	Impacts considered to be minor.

Table 8-4. (contd)

	Surry Power Station Site		Alternate Greenfield Site	
Impact Category	**Impact**	**Comments**	**Impact**	**Comments**
Socioeconomics	MODERATE	During construction, impacts would be MODERATE. Up to 1200 additional workers during the peak of the 3-year construction period, followed by reduction from current Surry Units 1 and 2 workforce of 990 to 150; tax base preserved. Impacts during operation would be SMALL. Transportation impacts associated with construction workers would be MODERATE.	MODERATE to LARGE	During construction, impacts would be MODERATE. Up to 1200 additional workers during the peak of the 3-year construction period. Surry County would experience loss of Units 1 and 2 tax base and employment associated with Units 1 and 2 with potentially LARGE associated impacts. Transportation impacts associated with construction workers would be MODERATE.
Aesthetics	MODERATE	MODERATE aesthetic impact due to impact of plant units and stacks on environmentally sensitive Colonial National Historical Park.	SMALL to LARGE	SMALL to MODERATE impact from plant and stacks. Additional impact that could be LARGE if a new transmission line is needed.
Historic and Archeological Resources	SMALL	Any potential impacts can likely be effectively managed.	SMALL	Same as Surry Power Station site; any potential impacts can likely be effectively managed.
Environmental Justice	MODERATE	Impacts on minority and low-income communities should be similar to those experienced by the population as a whole. Some impacts on housing may occur during construction; loss of 840 operating jobs at Surry Power Station could reduce employment prospects for minority and low-income populations.	MODERATE to LARGE	Impacts at alternate site vary depending on population distribution and makeup at site. Surry County would lose significant revenue, which could have MODERATE to LARGE impacts on minority and low-income populations.

For construction at an alternate greenfield site, the staff assumed that 45 ha (110 ac) would be needed for the plant and associated infrastructure (NRC 1996). Additional land could be impacted for construction of a transmission line and/or natural gas pipeline to serve the plant.

For any new natural gas-fired plant, additional land would be required for natural gas wells and collection stations. In the GEIS the staff estimated that approximately 1500 ha (3600 ac) would be needed for a 1000-MW(e) plant (NRC 1996). A replacement gas-fired plant for Surry Units 1 and 2 would be 1524 MW(e) and would affect proportionately more land. Partially offsetting these offsite land requirements would be the elimination of the need for uranium mining to supply fuel for Units 1 and 2. The NRC staff states in the GEIS (NRC 1996) that approximately 400 ha (1000 ac) would be affected for mining the uranium and processing it during the operating life of a 1000-MW(e) nuclear power plant. Overall, land-use impacts at both the Surry Power Station and an alternate greenfield location would be MODERATE to LARGE.

- **Ecology**

At the Surry Power Station site, there would be ecological land-related impacts for siting of the gas-fired plant. There would also be significant ecological impacts associated with bringing a new underground gas pipeline to the Surry Power Station site. Ecological impacts at an alternate site would depend on the nature of the land converted for the plant and the possible need for a new transmission line and/or gas pipeline. Construction of a transmission line and a gas pipeline to serve the plant would be expected to have temporary ecological impacts. Ecological impacts to the plant site and utility easements could include impacts on threatened or endangered species, wildlife habitat loss and reduced productivity, habitat fragmentation, and a local reduction in biological diversity. At an alternate site, the cooling makeup water intake and discharge could have aquatic resource impacts. Overall, the ecological impacts are considered MODERATE to LARGE at either location.

- **Water Use and Quality**

Each of the natural gas-fired units would include a heat-recovery boiler from which steam would turn an electric generator. Steam would be condensed and circulated back to the boiler for reuse. A natural gas-fired plant sited at Surry Power Station is assumed to use the existing once-through cooling system.

The staff assumed that a natural gas-fired plant located at the Surry Power Station would obtain potable, process, and fire-protection water from the series of groundwater wells that currently supply Units 1 and 2 (see Section 2.2.2). It is possible that a natural gas-fired plant sited at an alternate site could use groundwater. Groundwater withdrawal at an alternate site would likely require a permit. Groundwater withdrawal impacts are considered SMALL.

For alternate sites, the impact on the surface water would depend on the discharge volume and the characteristics of the receiving body of water. Intake from and discharge to any surface body of water would be regulated by the State. A natural gas-fired plant sited at an alternate site may use groundwater.

Water-quality impacts from sedimentation during construction of a natural gas-fired plant were characterized in the GEIS as SMALL (NRC 1996). The staff also noted in the GEIS that operational water quality impacts would be similar to, or less than, those from other generating technologies.

Overall, water-use and quality impacts at an alternate site are considered SMALL to MODERATE.

- **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. A new combined-cycle natural gas power plant would be subject to the new source performance standards for such units in 40 CFR 60 Subpart Da. Subpart Da establishes emission limits for particulates, opacity, SO_2, and NO_x. A new gas-fired plant would also be subject to the visibility and NO_x emission reduction provisions discussed in Section 8.2.1.

VEPCo projects the following emissions for the natural gas-fired alternative (VEPCo 2001):

Sulfur oxides - 122 MT/yr (134 tons/yr)
Nitrogen oxides - 459 MT/yr (506 tons/yr)
Carbon monoxide - 602 MT/yr (664 tons/yr)
PM_{10} particulates - 180 MT/yr (198 tons/yr)

A natural gas-fired plant would also have unregulated carbon dioxide emissions that could contribute to global warming.

In December 2000, EPA issued regulatory findings on emissions of hazardous air pollutants from electric utility steam-generating units. Natural gas-fired power plants were found by EPA to emit arsenic, formaldehyde, and nickel (EPA 2000b). Unlike coal- and oil-fired plants, however, EPA did not determine that regulation of emissions of hazardous air pollutants from natural gas-fired power plants should be regulated under Section 112 of the Clean Air Act.

Construction activities would result in temporary fugitive dust. Exhaust emissions would also come from vehicles and motorized equipment used during the construction process.

The preceding emissions would likely be the same at the Surry Power Station or at an alternate site. Impacts from the above emissions would be clearly noticeable, but would not be sufficient to destabilize air resources as a whole. The overall air-quality impact for a new natural gas-generating plant sited at the Surry Power Station or at an alternate site is considered MODERATE.

- **Waste**

The only significant waste generated at a natural gas-fired plant would be small amounts of spent SCR catalyst, which is used for control of NO_x emissions. In the GEIS, the staff concluded that waste generation from gas-fired technology would be minimal (NRC 1996). Gas firing results in very few combustion by-products because of the clean nature of the fuel. Other than spent SCR catalyst, waste generation at an operating gas-fired plant would be largely limited to typical office wastes. Construction-related debris would be generated during construction activities. Overall, the waste impacts would be SMALL for a natural gas-fired plant sited at the Surry Power Station or at an alternate site.

In the winter, it may become necessary for a replacement baseload natural gas-fired plant to operate on fuel oil due to lack of gas supply. Number 2 fuel oil would be used. Combustion of number 2 fuel oil does not produce any appreciable solid waste. Overall, the waste impacts associated with fuel oil combustion at a combined cycle plant are expected to be SMALL.

- **Human Health**

In the GEIS, the staff identifies cancer and emphysema as potential health risks from gas-fired plants (NRC 1996). The risk may be attributable to NO_x emissions that contribute to ozone formation, which in turn contribute to health risks. For any gas-fired plant, NO_x emissions would be regulated. Human health effects are not expected to be detectable or sufficiently minor that they would neither destabilize nor noticeably alter any important attribute of the resource. Overall, the impacts on human health of the natural gas-fired alternative sited at the Surry Power Station or at an alternate site are considered SMALL.

- **Socioeconomics**

Construction of a natural gas-fired plant would take approximately 3 years. Peak employment could be up to 1200 workers (NRC 1996). The staff assumed that construction

would take place while Units 1 and 2 continue operation and would be completed by the time they permanently cease operations. During construction, the communities surrounding the Surry Power Station site would experience demands on housing and public services that could have MODERATE impacts. These impacts would be tempered by construction workers commuting to the site from more distant cities such as Hampton, Norfolk, Chesapeake, Portsmouth, and Virginia Beach. After construction, the communities would be impacted by the loss of jobs. The current Units 1 and 2 workforce (990 workers) would decline through a decommissioning period to a minimal maintenance size. The new natural gas-fired plant would replace the nuclear tax base at Surry Power Station or provide a new tax base at an alternate site and approximately 150 permanent jobs. Siting at an alternate site would result in the loss of the nuclear tax base and associated employment in Surry County with potentially LARGE socioeconomic impacts.

In the GEIS (NRC 1996), the staff concluded that socioeconomic impacts from constructing a natural gas-fired plant would not be very noticeable and that the small operational workforce would have the lowest socioeconomic impacts of any nonrenewable technology. Compared to the coal-fired and nuclear alternatives, the smaller size of the construction workforce, the shorter construction time frame, and the smaller size of the operations workforce would mitigate socioeconomic impacts.

Transportation impacts associated with construction and operating personnel commuting to the plant site would depend on the population density and transportation infrastructure in the vicinity of the site. The impacts can be classified as MODERATE for siting at Surry Power Station or at an alternate site.

Overall, socioeconomic impacts resulting from construction of a natural gas-fired plant at Surry Power Station would be MODERATE. For construction at an alternate site, socioeconomic impacts would be MODERATE to LARGE.

- **Aesthetics**

The turbine buildings and stacks (approximately 60 m [200 ft] tall) would be visible during daylight hours from offsite. The gas-pipeline compressors would also be visible. Noise and light from the plant would be detectable offsite. At the Surry Power Station site, these impacts would result in a MODERATE aesthetic impact given the environmental sensitivity of Colonial National Historical Park and the expectations of visitors to national parks.

At an alternate site, the buildings and stacks would be visible offsite. If a new transmission line is needed, the aesthetic impact could be LARGE. Aesthetic impacts would be mitigated if the plant were located in an industrial area adjacent to other power plants. Overall, the

aesthetic impacts associated with a replacement natural gas-fired plant at an alternate site are categorized as SMALL to LARGE with site-specific factors determining the final categorization.

- **Historic and Archaeological**

  At both Surry Power Station and an alternate site, a cultural resource inventory would likely be needed for any onsite property that has not been previously surveyed. Other lands, if any, that are acquired to support the plant would also likely need an inventory of field cultural resources, identification and recording of existing historic and archaeological resources, and possible mitigation of adverse effects from subsequent ground-disturbing actions related to physical expansion of the plant site.

  Before construction at Surry Power Station or an alternate site, studies would likely be needed to identify, evaluate, and address mitigation of the potential impacts of new plant construction on cultural resources. The studies would likely be needed for all areas of potential disturbance at the proposed plant site and along associated corridors where new construction would occur (e.g., roads, transmission and pipeline corridors, or other rights-of-way). Impacts to cultural resources can be effectively managed under current laws and regulations and kept SMALL.

- **Environmental Justice**

  No environmental pathways or locations have been identified that would result in disproportionately high and adverse environmental impacts on minority and low-income populations if a replacement natural gas-fired plant were built at the Surry Power Station. Some impacts on housing availability and prices during construction might occur, and this could disproportionately affect minority and low-income populations. Closure of Surry Units 1 and 2 would result in a decrease in employment of approximately 840 operating employees, possibly offset by general growth in the immediate area. Resulting economic conditions could reduce employment prospects for minority or low-income populations. Overall, impacts are expected to be MODERATE.

  Impacts at an alternate site would depend upon the site chosen and the nearby population distribution. If a replacement natural gas-fired plant were constructed at an alternate site, Surry County would experience a significant loss of property tax revenue which would affect the County's ability to provide services and programs. Impacts to minority and low-income populations in Surry County could be MODERATE to LARGE.

8.2.2.2 Closed-Cycle Cooling System

The environmental impacts of constructing a natural gas-fired generation system at an alternate location using a closed-cycle cooling system with cooling towers are essentially the same as the impacts for a natural gas-fired plant using once-through cooling. However, there are some environmental differences between the closed-cycle and once-through cooling systems. Table 8-5 summarizes the incremental differences.

8.2.3 Nuclear Power Generation

Since 1997, the NRC has certified three new standard designs for nuclear power plants under 10 CFR Part 52, Subpart B. These designs are the U.S. Advanced Boiling Water Reactor (10 CFR Part 52, Appendix A), the System 80+ Design (10 CFR Part 52, Appendix B), and the AP600 Design (10 CFR Part 52, Appendix C). All of these plants are light-water reactors. Although no applications for a construction permit or a combined license based on these certified designs have been submitted to NRC, the submission of the design certification applications indicates continuing interest in the possibility of licensing new nuclear power plants. In addition, recent volatility in prices of natural gas and electricity have made new nuclear power plant construction more attractive from a cost standpoint. Consequently, construction of a new nuclear power plant at the Surry Power Station site using the existing once-through cooling system and at an alternate greenfield site using both closed- and open-cycle cooling are considered in this section. The staff assumed that the new nuclear plant would have a 40-year lifetime.

NRC has summarized environmental data associated with the uranium fuel cycle in Table S-3 of 10 CFR 51.51. The impacts shown in Table S-3 are representative of the impacts that would be associated with a replacement nuclear power plant built to one of the certified designs sited at the Surry Power Station or an alternate site. The impacts shown in Table S-3 are for a 1000-MW(e) reactor and would need to be adjusted to reflect replacement of Units 1 and 2, which have a capacity of 1602 MW(e). The environmental impacts associated with transporting fuel and waste to and from a light-water-cooled nuclear power reactor are summarized in Table S-4 of 10 CFR 51.52. The summary of NRC's findings on NEPA issues for license renewal of nuclear power plants in Table B-1 of 10 CFR Part 51, Subpart A, Appendix B, is also relevant, although not directly applicable, for consideration of environmental impacts associated with the operation of a replacement nuclear power plant. Additional environmental impact information for a replacement nuclear power plant using once-through cooling is presented in Section 8.2.3.1 and using closed-cycle cooling in Section 8.2.3.2.

Table 8-5. Summary of Environmental Impacts of Natural Gas-Fired Generation at an Alternate Greenfield Site with Closed-Cycle Cooling Utilizing Cooling Towers

Impact Category	Change in Impacts from Once-Through Cooling System
Land Use	Required 10-12 additional ha (25-30 ac) for cooling towers and associated infrastructure.
Ecology	Impact would depend on ecology at the site. Additional impact to terrestrial ecology from cooling tower drift. Reduced impact to aquatic ecology.
Surface Water Use and Quality	Discharge of cooling tower blowdown containing dissolved solids. Discharge would be regulated by the State. Decreased water withdrawal and less thermal load on receiving body of water. Consumptive use of water due to evaporation from cooling towers.
Groundwater Use and Quality	No change
Air Quality	No change
Waste	No change
Human Health	No change
Socioeconomics	No change
Aesthetics	Introduction of cooling towers and associated plume. Possible noise impact from operation of cooling towers.
Historic and Archaeological Resources	No change
Environmental Justice	No change

8.2.3.1 Once-Through Cooling System

The overall impacts of the nuclear generating system are discussed in the following sections. The impacts are summarized in Table 8-6. The extent of impacts at an alternate greenfield site will depend on the location of the particular site selected.

- **Land Use**

  The existing facilities and infrastructure at the Surry Power Station site would be used to the extent practicable, limiting the amount of new construction that would be required. Specifically, the staff assumed that a replacement nuclear power plant would use the existing cooling system, switchyard, offices, and transmission line rights-of-way.

  A replacement nuclear power plant at Surry Power Station would require approximately 200 ha (500 ac), some of which may be previously undeveloped land. There would be no net change in land needed for uranium mining because land for the new nuclear plant would offset land needed to supply uranium for fuel for Units 1 and 2.

  The impact of a replacement nuclear generating plant on land use at the Surry Power Station site is best characterized as MODERATE. The impact would be greater than the OL renewal alternative.

  Land-use requirements at an alternate site would be approximately 200-400 ha (500-1000 ac) plus the possible need for a new transmission line (NRC 1996). In addition, it may be necessary to construct a rail spur to an alternate site to bring in equipment during construction. Depending particularly on transmission line routing, siting a new nuclear plant at an alternate site could result in MODERATE to LARGE land-use impacts.

- **Ecology**

  Locating a replacement nuclear power plant at the Surry Power Station site would alter ecological resources because of the need to convert land to an industrial use. Some of this land, however, would have been previously disturbed.

  Siting at the Surry Power Station would have a MODERATE ecological impact that would be greater than renewal of the Units 1 and 2 OLs.

  At an alternate site, there would be construction impacts and new incremental operational impacts. Even assuming siting at a previously disturbed area, the impacts would alter the

Table 8-6. Summary of Environmental Impacts of New Nuclear Generation at Surry Power Station and an Alternate Greenfield Site Using Once-Through Cooling

	Surry Power Station Site		Alternate Greenfield Site	
Impact Category	**Impact**	**Comments**	**Impact**	**Comments**
Land Use	MODERATE	Requires approximately 200 ha (500 ac) for the plant	MODERATE to LARGE	Requires approximately 200-400 ha (500-1000 ac) for the plant. Possible additional land if a new transmission line is needed.
Ecology	MODERATE	Uses undeveloped areas at current Surry Power Station site plus additional offsite land. Potential habitat loss and fragmentation and reduced productivity and biological diversity on offsite land.	MODERATE to LARGE	Impact depends on location and ecology of the site, surface-water body used for intake and discharge, and transmission line route; potential habitat loss and fragmentation; reduced productivity and biological diversity.
Water Use and Quality	SMALL	Uses existing once-through cooling system	SMALL to MODERATE	Impact will depend on the volume of water withdrawn and discharged and the characteristics of the surface water body.
Air Quality	SMALL	Fugitive emissions and emissions from vehicles and equipment during construction. Small amount of emissions from diesel generators and possibly other sources during operation.	SMALL	Same impacts as Surry Power Station site
Waste	SMALL	Waste impacts for an operating nuclear power plant are set out in 10 CFR Part 51, Appendix B, Table B-1. Debris would be generated and removed during construction.	SMALL	Same impacts as Surry Power Station site
Human Health	SMALL	Human health impacts for an operating nuclear power plant are set out in 10 CFR Part 51, Appendix B, Table B-1.	SMALL	Same impacts as Surry Power Station site

Table 8-6. (contd)

	Surry Power Station Site		Alternate Greenfield Site	
Impact Category	**Impact**	**Comments**	**Impact**	**Comments**
Socioeconomics	MODERATE to LARGE	During construction, impacts would be MODERATE to LARGE. Up to 2500 workers during the peak of the 6-year construction period. Operating workforce assumed to be similar to Units 1 & 2. Surry County tax base preserved.	MODERATE to LARGE	Construction impacts depend on location. Impacts at a rural location could be LARGE. Surry County would experience loss of a significant tax base and employment with potentially LARGE impacts.
		Transportation impacts associated with commuting construction workers could be MODERATE to LARGE. Transportation impacts during operation would be SMALL.		Transportation impacts associated with commuting construction workers could be MODERATE to LARGE. Transportation impacts during operation would be SMALL to MODERATE.
Aesthetics	SMALL	No exhaust stacks or cooling towers would be needed. Daytime visual impact could be mitigated by landscaping and appropriate color selection for buildings. Visual impact at night could be mitigated by reduced use of lighting and appropriate shielding. Noise impacts would be relatively small and could be mitigated.	SMALL to LARGE	Similar to impacts at Surry Power Station. Potential LARGE impact if a new transmission line is needed.
Historic and Archeological Resources	SMALL	Any potential impacts can likely be effectively managed.	SMALL	Any potential impacts can likely be effectively managed.
Environmental Justice	SMALL	Impacts on minority and low-income communities should be similar to those experienced by the population as a whole. Some impacts on housing may occur during construction.	MODERATE to LARGE	Impacts will vary depending on population distribution and makeup at the site. Impacts to minority and low-income residents of Surry County associated with closure of Surry Units 1 and 2 could be significant.

ecology. Impacts could include wildlife habitat loss, reduced productivity, habitat fragmentation, and a local reduction in biological diversity. Use of cooling water from a nearby surface water body could have adverse aquatic resource impacts. If needed, construction and maintenance of the transmission line would have ecological impacts. Overall, the ecological impacts at an alternate site would be MODERATE to LARGE.

- **Water Use and Quality**

  The staff assumed that a replacement nuclear plant alternative at the Surry Power Station would use the existing cooling system, which would minimize incremental water-use and quality impacts. Surface-water impacts are expected to remain SMALL; the impacts would be sufficiently minor so they would not noticeably alter any important attribute of the resource.

  The staff assumed that a new nuclear power plant located at the Surry Power Station would obtain potable, process, and fire-protection water from onsite groundwater wells similarly to the current practice for Units 1 and 2 (see Section 2.2.2). Some erosion and sedimentation would likely occur during construction as a result of land clearing.

  For alternate sites, the impact on the surface water would depend on the discharge volume and the characteristics of the receiving body of water. Intake from and discharge to any surface body of water would be regulated by the State. The impacts would be SMALL to MODERATE.

  A nuclear power plant sited at an alternate site may use groundwater. Groundwater withdrawal at an alternate site would likely require a permit. Groundwater withdrawal impacts would depend on availability and how the water is withdrawn, but overall are considered SMALL.

- **Air Quality**

  Construction of a new nuclear plant sited at the Surry Power Station or an alternate site would result in fugitive emissions during the construction process. Exhaust emissions would also come from vehicles and motorized equipment used during the construction process. An operating nuclear plant would have minor air emissions associated with diesel generators. These emissions would be regulated by the Virginia Department of Environmental Quality or another state. Overall, emissions and associated impacts are considered SMALL.

- **Waste**

  The waste impacts associated with operation of a nuclear power plant are set out in Table B-1 of 10 CFR Part 51, Subpart A, Appendix B. In addition to the impacts shown in Table B-1, construction-related debris would be generated during construction activities and removed to an appropriate disposal site. Overall, waste impacts are considered SMALL.

Siting the replacement nuclear power plant at a site other than the Surry Power Station would not alter waste generation. Therefore, the impacts would be SMALL.

- **Human Health**

  Human health impacts for an operating nuclear power plant are set out in 10 CFR Part 51, Subpart A, Appendix B, Table B-1. Overall, human health impacts are considered SMALL.

  Siting the replacement nuclear power plant at a site other than the Surry Power Station would not alter human health impacts. Therefore, the impacts would be SMALL.

- **Socioeconomics**

  The construction period and the peak workforce associated with construction of a new nuclear power plant are currently unquantified (NRC 1996). In the absence of quantified data, the staff assumed a construction period of 6 years and a peak workforce of 2500. The staff assumed that construction would take place while existing Units 1 and 2 continue operation and would be completed by the time Units 1 and 2 permanently cease operations. During construction, the communities surrounding the Surry Power Station site would experience demands on housing and public services that could have MODERATE to LARGE impacts. These impacts would be tempered by construction workers commuting to the site from more distant communities. After construction, the communities would be impacted by the loss of the construction jobs.

  The replacement nuclear units are assumed to have an operating workforce comparable to the 990 workers currently working at Units 1 and 2. The replacement nuclear units would provide a new tax base to offset the loss of tax base associated with decommissioning of Units 1 and 2. The appropriate characterization of nontransportation socioeconomic impacts for operating replacement nuclear units constructed at the Surry Power Station site would be SMALL.

  During the 6-year construction period, up to 2500 construction workers would be working at the Surry Power Station site in addition to the 990 workers at Units 1 and 2. The addition of the construction workers could place significant traffic loads on existing highways, particularly those leading to the Surry Power Station site. Such impacts would be MODERATE to LARGE. Transportation impacts related to commuting of plant operating personnel would be similar to current impacts associated with operation of Units 1 and 2 and are considered SMALL.

Construction of a replacement nuclear power plant at an alternate site would relocate some socioeconomic impacts, but would not eliminate them. Surry County and surrounding communities would experience the impact of Surry Units 1 and 2 operational job loss and the loss of tax base with potentially LARGE impacts given Surry County's heavy dependence on tax revenue from the Surry Power Station. The communities around the new site would have to absorb the impacts of a large, temporary workforce (up to 2500 workers at the peak of construction) and a permanent workforce of approximately 880 workers. In the GEIS (NRC 1996), the staff noted that socioeconomic impacts at a rural site would be larger than at an urban site because more of the peak construction workforce would need to move to the area to work. The Surry Power Station site is within commuting distance of a number of relatively large cities and, therefore, is not considered a rural site. Alternate sites would need to be analyzed on a case-by-case basis. Socioeconomic impacts at a rural site could be LARGE. Transportation-related impacts associated with commuting construction workers at an alternate site are site-dependent, but could be MODERATE to LARGE. Transportation impacts related to commuting of plant operating personnel would also be site-dependent, but can be characterized as SMALL to MODERATE.

- **Aesthetics**

The containment buildings for a replacement nuclear power plant sited at the Surry Power Station and other associated buildings would likely be visible in daylight hours over many miles. Visual impacts could be mitigated by landscaping and selecting a color for buildings that is consistent with the environment. The visual impact could also be mitigated by below-grade construction similar to Surry Units 1 and 2. Visual impact at night could be mitigated by reduced use of lighting and appropriate use of shielding. No exhaust stacks would be needed. No cooling towers would be needed, assuming use of the existing once-through cooling system.

Noise from operation of a replacement nuclear power plant would potentially be audible offsite in calm wind conditions or when the wind is blowing in the direction of the hearer. Mitigation measures, such as reduced or no use of outside loudspeakers, can be employed to reduce noise level and keep the impact SMALL.

At an alternate site, there would be an aesthetic impact from the buildings. There would also be a significant aesthetic impact if a new transmission line were needed. Noise and light from the plant would be detectable offsite. The impact of noise and light would be mitigated if the plant is located in an industrial area adjacent to other power plants. Overall, the aesthetic impacts associated with locating at an alternative site can be categorized as

SMALL; however, the impact could be LARGE if a new transmission line is needed to connect the plant to the power grid.

- **Historic and Archaeological Resources**

  At both the Surry Power Station site and an alternate site, a cultural resource inventory would likely be needed for any onsite property that has not been previously surveyed. Other lands, if any, that are acquired to support the plant would also likely need an inventory of field cultural resources, identification and recording of existing historic and archaeological resources, and possible mitigation of adverse effects from subsequent ground-disturbing actions related to physical expansion of the plant site.

  Before construction at the Surry Power Station site or another site, studies would likely be needed to identify, evaluate, and address mitigation of the potential impacts of new plant construction on cultural resources. The studies would likely be needed for all areas of potential disturbance at the proposed plant site and along associated corridors where new construction would occur (e.g., roads, transmission corridors, rail lines, or other rights-of-way). Historic and archaeological resource impacts can generally be effectively managed and are considered SMALL.

- **Environmental Justice**

  No environmental pathways or locations have been identified that would result in disproportionately high and adverse environmental impacts on minority and low-income populations if a replacement nuclear plant were built at the Surry Power Station site. Some impacts on housing availability and prices during construction might occur, and this could disproportionately affect minority and low-income populations. After completion of construction, it is possible that the ability of local governments to maintain social services could be reduced at the same time as diminished economic conditions reduce employment prospects for minority and low-income populations. Overall, however, impacts are expected to be SMALL.

  Impacts at an alternate site would depend upon the site chosen and the nearby population distribution. If a replacement nuclear plant were constructed at an alternate site, Surry County would experience a significant loss of property tax revenue, which would affect the County's ability to provide services and programs. Impacts to minority and low-income populations in Surry County could be MODERATE to LARGE.

8.2.3.2 Closed-Cycle Cooling System

The environmental impacts of constructing a nuclear power plant at an alternate greenfield site using closed-cycle cooling with cooling towers are essentially the same as the impacts for a nuclear power plant using a once-through system. However, there are minor environmental differences between the closed-cycle and once-through cooling systems. Table 8-7 summarizes the incremental differences.

8.2.4 Purchased Electrical Power

If available, purchased power from other sources could potentially obviate the need to renew the Surry Units 1 and 2 OLs. VEPCo currently has purchase agreements for 145 MW from the Southeastern Power Administration and approximately 3500 MW of non-utility generation (VEPCo 2001). Overall, Virginia is a net importer of electricity.

To replace Surry Units 1 and 2 capacity with imported power, VEPCo would need to construct a new 500-kV transmission line, which VEPCo estimates would be approximately 160 km (100 mi) long (VEPCo 2001). Assuming a 0.09 km (300 ft) easement width, the transmission line would impact approximately 15 km^2 (6 mi^2).

Imported power from Canada or Mexico is unlikely to be available for replacement of Surry Power Station Units 1 and 2 capacity. In Canada, 62 percent of the country's electricity capacity is derived from renewable energy sources, principally hydropower (DOE/EIA 2001b). Canada has plans to continue developing hydroelectric power, but the plans generally do not include large-scale projects (DOE/EIA 2001b). Canada's nuclear generation is projected to increase by 1.7 percent by 2020, but its share of power generation in Canada is projected to decrease from 14 percent currently to 13 percent by 2020 (DOE/EIA 2001b). EIA projects that total gross U.S. imports of electricity from Canada and Mexico will gradually increase from 47.9 billion kWh in year 2000 to 66.1 billion kWh in year 2005, and then gradually decrease to 47.4 billion kWh in year 2020 (DOE/EIA 2001a). On balance, it is unlikely that electricity imported from Canada or Mexico would be able to replace the Surry Units 1 and 2 capacity.

If power to replace Surry Power Station Units 1 and 2 capacity were to be purchased from sources within the U.S. or a foreign country, the generating technology would likely be one of those described in this SEIS and in the GEIS (probably coal, natural gas, or nuclear). The description of the environmental impacts of other technologies in Chapter 8 of the GEIS is representative of the environmental impacts associated with the purchased electrical power alternative to renewal of the Surry Units 1 and 2 OLs. Under the purchased power alternative, the environmental impacts of imported power would still occur, but would be located elsewhere within the region, nation, or another country.

Table 8-7. Summary of Environmental Impacts of a New Nuclear Power Plant Sited at an Alternate Greenfield Site with Closed-Cycle Cooling

Impact Category	Change in Impacts from Once-Through Cooling System
Land Use	Required 10-12 additional ha (25-30 ac) for cooling towers and associated infrastructure.
Ecology	Impact would depend on ecology at the site. Additional impact to terrestrial ecology from cooling-tower drift. Reduced impact to aquatic ecology.
Surface Water Use and Quality	Discharge of cooling-tower blowdown containing dissolved solids. Discharge would be regulated by the State. Decreased water withdrawal and less thermal load on receiving body of water. Consumptive use of water due to evaporation from cooling towers.
Groundwater Use and Quality	No change
Air Quality	No change
Waste	No change
Human Health	No change
Socioeconomics	No change
Aesthetics	Introduction of cooling towers and associated plume. Natural draft towers could be up to 158 m (520 ft). Mechanical draft towers could be up to 30 m (100 ft) high and also have an associated noise impact.
Historic and Archaeological Resources	No change
Environmental Justice	No change

8.2.5 Other Alternatives

Other generation technologies are discussed in the following subsections.

8.2.5.1 Oil-Fired Generation

EIA projects that oil-fired plants will account for very little of the new generation capacity in the United States during the 2000 to 2020 time period because of higher fuel costs and lower efficiencies (DOE/EIA 2001a). Oil-fired operation is more expensive than nuclear or coal-fired operation. In addition, future increases in oil prices are expected to make oil-fired generation increasingly more expensive than coal-fired generation. The high cost of oil has prompted a steady decline in its use for electricity generation. Also, construction and operation of an oil-fired plant would have environmental impacts. For example, in Section 8.3.11 of the GEIS, the staff estimated that construction of a 1000-MWe oil-fired plant would require about 50 ha (120 ac) (NRC 1996). Additionally, operation of oil-fired plants would have environmental impacts (including impacts on the aquatic environment and air) that would be similar to those from a coal-fired plant.

8.2.5.2 Wind Power

Virginia is in a wind power Class 1 region (average wind speeds at 10-m (30-ft) elevation of 0 to 4.4 m/s [9.8 mph]). Class 1 has the lowest potential for wind energy generation (DOE 2001a). Wind turbines are economical in wind power Classes 4 through 7 (average wind speeds of 5.6 to 9.4 m/s [12.5 to 21.1 mph] [DOE 2001a]). The staff concludes that locating a wind-energy facility on or near the Surry Power Station site as a replacement for Surry Power Station generating capacity would not be economically feasible given the current state of wind energy generation technology. As of December 31, 2000, there were no grid-connected wind power plants in Virginia or North Carolina (NREL 2001).

8.2.5.3 Solar Power

Solar technologies use the sun's energy and light to provide heat and cooling, light, hot water, and electricity for homes, businesses, and industry. Solar power technologies (photovoltaic and thermal) cannot currently compete with conventional fossil-fueled technologies in grid-connected applications due to higher capital costs per kilowatt of capacity. The average capacity factor of photovoltaic cells is about 25 percent (NRC 1996), and the capacity factor for solar thermal systems is about 25 to 40 percent (NRC 1996). Energy storage requirements limit the use of solar-energy systems as baseload electricity supply.

There are substantial impacts to natural resources (wildlife habitat, land-use, and aesthetic impacts) from construction of solar-generating facilities. As stated in the GEIS, land requirements are high—14,000 ha (35,000 ac) per 1000 MW(e) for photovoltaic (NRC 1996) and approximately 6000 ha (14,000 ac) per 1000 MW(e) for solar thermal systems (NRC 1996). Neither type of solar electric system would fit at the Surry Power Station site, and both would have large environmental impacts at a greenfield site.

The Surry Power Station site receives approximately 4 kWh of direct normal solar radiation per square meter per day compared to 7 to 8 kWh of solar radiation per square meter per day in areas of the western U.S., such as California, which are most promising for solar technologies (DOE/EIA 2000a). Because of the natural resource impacts (land and ecological), the area's relatively low rate of solar radiation, and the high cost, solar power is not deemed a feasible baseload alternative to renewal of the Surry Power Station Units 1 and 2 OLs. Some onsite generated solar power, e.g., from rooftop photovoltaic applications, may substitute for electric power from the grid. Implementation of solar generation on a scale large enough to replace Surry Units 1 and 2 would likely result in LARGE environmental impacts.

8.2.5.4 Hydropower

Virginia has an estimated 617 MW of undeveloped hydroelectric resources (INEEL 1997). This amount is less than needed to replace the 1602 MW(e) capacity of Surry Units 1 and 2. As stated in Section 8.3.4 of the GEIS, hydropower's percentage of U.S. generating capacity is expected to decline because hydroelectric facilities have become difficult to site as a result of public concern about flooding, destruction of natural habitat, and alteration of natural river courses. In the GEIS, the staff estimated that land requirements for hydroelectric power are approximately 400,000 ha (1 million ac) per 1000 MW(e) (NRC 1996). Replacement of Surry Power Station Units 1 and 2 generating capacity would require flooding more than this amount of land. Due to the relatively low amount of undeveloped hydropower resource in Virginia and the large land-use and related environmental and ecological resource impacts associated with siting hydroelectric facilities large enough to replace Surry Units 1 and 2, the staff concludes that local hydropower is not a feasible alternative to renewal of the Surry Units 1 and 2 OLs. Any attempts to site hydroelectric facilities large enough to replace Surry Units 1 and 2 would result in LARGE environmental impacts.

8.2.5.5 Geothermal Energy

Geothermal energy has an average capacity factor of 90 percent and can be used for baseload power where available. However, geothermal technology is not widely used as baseload generation due to the limited geographical availability of the resource and immature status of the technology (NRC 1996). As illustrated by Figure 8-4 in the GEIS, geothermal plants are

most likely to be sited in the western continental U.S., Alaska, and Hawaii, where hydrothermal reservoirs are prevalent. There is no feasible eastern location for geothermal capacity to serve as an alternative to Surry Units 1 and 2. The staff concludes that geothermal energy is not a feasible alternative to renewal of the Surry Units 1 and 2 OLs.

8.2.5.6 Wood Waste

A wood-burning facility can provide baseload power and operate with an average annual capacity factor of around 70 to 80 percent and with 20 to 25 percent efficiency (NRC 1996). The fuels required are variable and site-specific. A significant barrier to the use of wood waste to generate electricity is the high delivered-fuel cost and high construction cost per MW of generating capacity. The larger wood-waste power plants are only 40 to 50 MW(e) in size. Estimates in the GEIS suggest that the overall level of construction impact per MW of installed capacity should be approximately the same as that for a coal-fired plant, although facilities using wood waste for fuel would be built at smaller scales (NRC 1996). Like coal-fired plants, wood-waste plants require large areas for fuel storage and processing and involve the same type of combustion equipment.

Due to uncertainties associated with obtaining sufficient wood and wood waste to fuel a base-load generating facility, ecological impacts of large-scale timber cutting (e.g., soil erosion and loss of wildlife habitat), and high inefficiency, the staff has determined that wood waste is not a feasible alternative to renewing the Surry Units 1 and 2 OLs.

8.2.5.7 Municipal Solid Waste

Municipal waste combustors incinerate the waste and use the resultant heat to generate steam, hot water, or electricity. The combustion process can reduce the volume of waste by up to 90 percent and the weight of the waste by up to 75 percent (EPA 2001). Municipal waste combustors use three basic types of technologies: mass burn, modular, and refuse-derived fuel (DOE/EIA 2001c). Mass-burning technologies are most commonly used in the U.S. This group of technologies process raw municipal solid waste “as is,” with little or no sizing, shredding, or separation before combustion. The initial capital costs for municipal solid-waste plants are greater than for comparable steam-turbine technology at wood-waste facilities. This is due to the need for specialized waste-separation and -handling equipment for municipal solid waste (NRC 1996).

Growth in the municipal waste combustion industry slowed dramatically during the 1990s after rapid growth during the 1980s. The slower growth was due to three primary factors: (1) the Tax Reform Act of 1986, which made capital-intensive projects such as municipal waste combustion facilities more expensive relative to less capital-intensive waste disposal

alternatives such as landfills; (2) the 1994 Supreme Court decision (*C&A Carbone v. Town of Clarkstown*), which struck down local flow control ordinances that required waste to be delivered to specific municipal waste combustion facilities rather than landfills that may have had lower fees; and (3) increasingly stringent environmental regulations that increased the capital cost necessary to construct and maintain municipal waste combustion facilities (DOE/EIA 2001c).

Municipal solid waste combustors generate an ash residue that is buried in landfills. The ash residue is composed of bottom ash and fly ash. Bottom ash refers to that portion of the unburned waste that falls to the bottom of the grate or furnace. Fly ash represents the small particles that rise from the furnace during the combustion process. Fly ash is generally removed from flue-gases using fabric filters and/or scrubbers (DOE/EIA 2001c).

Currently, there are approximately 102 waste-to-energy plants operating in the U.S. These plants generate approximately 2800 MW(e), or an average of approximately 28 MW(e) per plant (Integrated Waste Services Association 2001). The staff concludes that generating electricity from municipal solid waste would not be a feasible alternative to replace the 1602 MW(e) baseload capacity of Surry Units 1 and 2 and, consequently, would not be a feasible alternative to renewal of the Surry Units 1 and 2 OLs.

8.2.5.8 Other Biomass-Derived Fuels

In addition to wood and municipal solid waste fuels, there are several other concepts for fueling electric generators, including burning crops, converting crops to a liquid fuel such as ethanol, and gasifying crops (including wood waste). In the GEIS, the staff stated that none of these technologies has progressed to the point of being competitive on a large scale or of being reliable enough to replace a baseload plant such as Surry Units 1 and 2 (NRC 1996). For these reasons, such fuels do not offer a feasible alternative to renewal of the Surry Units 1 and 2 OLs.

8.2.5.9 Fuel Cells

Fuel cells work without combustion and its environmental side-effects. Power is produced electrochemically by passing a hydrogen-rich fuel over an anode and air over a cathode and separating the two by an electrolyte. The only by-products are heat, water, and carbon dioxide. Hydrogen fuel can come from a variety of hydrocarbon resources by subjecting them to steam under pressure. Phosphoric acid fuel cells are generally considered first-generation technology. Higher-temperature second-generation fuel cells achieve higher fuel-to-electricity and thermal efficiencies. The higher temperatures contribute to improved efficiencies and give the second-generation fuel cells the capability to generate steam for cogeneration and combined-cycle operations. DOE projects that by 2003, two second-generation fuel-cell

technologies using molten carbonate and solid oxide technology, respectively, will be commercially available in sizes up to 2 MW at a cost of $1000 to $1500 per kW of installed capacity (DOE 2001b). For comparison, the installed capacity cost for a natural gas-fired combined-cycle plant is approximately $456 per kW (DOE/EIA 2001a). As market acceptance and manufacturing capacity increase, natural gas-fueled fuel-cell plants in the 50- to 100-MW range are projected to become available (DOE 2001b). At the present time, however, fuel cells are not economically or technologically competitive with other alternatives for baseload electricity generation. Fuel cells are, consequently, not a feasible alternative to renewal of the Surry Units 1 and 2 OLs.

8.2.5.10 Delayed Retirement

The only VEPCo generating plants currently scheduled for retirement are Possum Point Units 1 and 2. These oil-fired units each have a nameplate generating capacity[(a)] of 69 MW (DOE/EIA 2000b). The Possum Point facility is located about 25 miles south of Washington, D.C. Delayed retirement of Possum Point Units 1 and 2 would not come close to replacing the 1602-MW(e) capacity of Surry Units 1 and 2. For this reason, delayed retirement of VEPCo generating units would not be a feasible alternative to renewal of the Surry Units 1 and 2 OLs.

8.2.5.11 Utility-Sponsored Conservation

VEPCo has developed residential, commercial, and industrial programs to reduce both peak demands and daily energy consumption. These programs are commonly referred to as demand-side management (DSM). VEPCo currently operates the following DSM programs: Rate Schedule SG (standby generation), Rate Schedule CS (curtailable service), Rider J (interruptible electric water heater service), and the Real Time Pricing Rate. VEPCo projects that by the year 2007, its DSM programs will reduce peak power requirements in the summer and winter by 74 and 130 MW, respectively (VEPCo 2001). VEPCo also projects that energy requirements in 2007 will be reduced by 14 gigawatt hours, 94 percent of which would be from load-management programs (VEPCo 2001).

Historic and projected reduction in generation needs as a result of DSM programs have been credited in VEPCo's planning to meet projected customer demand. Because these DSM savings are part of the long-range plan for meeting projected demand, they are not available offsets for Surry Units 1 and 2. Therefore, the conservation option is not considered a reasonable replacement for the OL renewal alternative.

(a) The nameplate generating capacity is the full-load continuous rating of a generating unit.

8.2.6 Combination of Alternatives

Even though individual alternatives to Surry Units 1 and 2 might not be sufficient to replace Surry Units 1 and 2 capacity due to the small size of the resource or lack of cost-effective opportunities, it is conceivable that a combination of alternatives might be cost-effective.

As discussed in Section 8.2, Surry Units 1 and 2 have a combined average net capacity of 1602 MW(e). For the coal and natural gas alternatives, VEPCo assumed three standard 508-MW(e) units as potential replacements for Surry Units 1 and 2 (VEPCo 2001). This approach is followed in this SEIS, although it results in some environmental impacts that are roughly 5 percent lower than if full replacement capacity were constructed.

There are many possible combinations of alternatives. Table 8-8 contains a summary of the environmental impacts of an assumed combination of alternatives consisting of 1016 MW(e) of combined cycle natural-gas-fired generation at Surry Power Station using the existing once-through cooling system and at an alternate greenfield location using closed-cycle cooling, 293 MW(e) purchased from other generators, and 293 MW(e) gained from additional DSM measures. The impacts associated with the combined cycle natural-gas-fired units are based on the gas-fired generation impact assumptions discussed in Section 8.2.2, adjusted for the reduced generating capacity. While the DSM measures would have few environmental impacts, operation of the new gas-fired plant would result in increased emissions and environmental impacts. The environmental impacts associated with power purchased from other generators would still occur, but would be located elsewhere within the region, nation, or another country, as discussed in Section 8.2.4. The environmental impacts associated with purchased power are not shown in Table 8-8. The staff concludes that it is very unlikely that the environmental impacts of any reasonable combination of generating and conservation options could be reduced to the level of impacts associated with renewal of the Surry Units 1 and 2 OLs.

8.3 Summary of Alternatives Considered

The environmental impacts of the proposed action, renewal of the OLs for Surry Units 1 and 2, are SMALL for all impact categories (except collective offsite radiological impacts from the fuel cycle and from high level waste and spent fuel disposal, for which a single significance level was not assigned). The following alternative actions were considered: no-action alternative (discussed in Section 8.1), new generation alternatives (from coal, natural gas, and nuclear discussed in Sections 8.2.1 through 8.2.3, respectively), purchased electrical power (discussed in Section 8.2.4), alternative technologies (discussed in Section 8.2.5), and the combination of alternatives (discussed in Section 8.2.6).

Table 8-8. Summary of Environmental Impacts for an Assumed Combination of Generating and Acquisition Alternatives

	Surry Power Station Site		Alternate Greenfield Site	
Impact Category	**Impact**	**Comments**	**Impact**	**Comments**
Land Use	MODERATE to LARGE	9 ha (23 ac) for powerblock, offices, roads, and parking areas. Additional impact of up to approximately 1200 ha (3000 ac) for construction of an underground gas pipeline.	MODERATE to LARGE	30 ha (74 ac) for power- block, offices, roads, and parking areas. Additional impact for construction of an underground natural gas pipeline and a transmission line.
Ecology	MODERATE to LARGE	Uses undeveloped areas at Surry Power Station site plus land for a new gas pipeline.	MODERATE to LARGE	Impact depends on location and ecology of the site, surface-water body used for intake and discharge, and transmission and pipeline routes; potential habitat loss and fragmentation; reduced productivity and biological diversity impact to terrestrial ecology from cooling tower drift.
Water Use and Quality	SMALL	Uses existing once-through cooling system	SMALL to MODERATE	Impact depends on volume of water withdrawal and discharge and characteristics of surface-water body. Discharge of cooling tower blowdown will have impacts. Consumptive use of water due to evaporation from cooling towers.
Air Quality	MODERATE	Sulfur oxides • 81 MT/yr (89 tons/yr) Nitrogen oxides • 306 MT/yr (337 tons/yr) Carbon monoxide • 402 MT/yr (443 tons/yr) PM_{10} particulates • 120 MT/yr (132 tons/yr) Some hazardous air pollutants	MODERATE	Same as siting at Surry Power Station
Waste	SMALL	The only significant waste would be spent SCR catalyst used for control of NO_x emissions.	SMALL	The only significant waste would be spent SCR catalyst used for control of NO_x emissions.
Human Health	SMALL	Impacts considered to be minor.	SMALL	Impacts considered to be minor.

Table 8-8. (contd)

	Surry Power Station Site		Alternate Greenfield Site	
Impact Category	**Impact**	**Comments**	**Impact**	**Comments**
Socioeconomics	MODERATE	During construction, impacts would be MODERATE. Up to 1200 additional workers during the peak of the 3-year construction period, followed by reduction from current Surry Units 1 and 2 workforce of 990 to approximately 100; tax base preserved. Impacts during operation would be SMALL. Transportation impacts associated with construction workers would be MODERATE.	MODERATE to LARGE	Construction impacts depend on location, but could be significant if location is in a rural area. Surry County would experience loss of tax base and employment with potentially LARGE impacts. Impacts during operation would be SMALL. Transportation impacts associated with construction workers would be MODERATE.
Aesthetics	MODERATE	MODERATE aesthetic impact due to impact of plant units and stacks on environmentally sensitive Colonial National Historical Park.	SMALL to LARGE	MODERATE impact from plant and stacks. Additional impact could be LARGE if a new transmission line is needed.
Historic and Archeological Resources	SMALL	Any potential impacts can likely be effectively managed.	SMALL	Any potential impacts can likely be effectively managed.
Environmental Justice	MODERATE	Impacts on minority and low-income communities should be similar to those experienced by the population as a whole. Some impacts on housing may occur during construction; loss of approximately 890 operating jobs at Surry Power Station could reduce employment prospects for minority and low-income populations.	MODERATE to LARGE	Impacts vary depending on population distribution and makeup at site. Surry County would lose significant property tax revenue, which could have MODERATE to LARGE impacts on minority and low-income populations.

The no-action alternative would result in decommissioning Surry Units 1 and 2 and would require replacing electrical generating capacity by (1) demand-side management and energy conservation, (2) power purchased from other electricity providers, (3) generating alternatives other than Surry Units 1 and 2, or (4) some combination of these options. For each of the new generation alternatives (coal, natural gas, and nuclear), the environmental impacts would not be less than the impacts of license renewal. For example, the land-disturbance impacts resulting from construction of any new facility would be greater than the impacts of continued operation of Surry Units 1 and 2. The impacts of purchased electrical power would still occur, but would occur elsewhere. Alternative technologies are not considered feasible at this time, and it is very unlikely that the environmental impacts of any reasonable combination of generation and conservation options could be reduced to the level of impacts associated with renewal of the OLs for Surry Units 1 and 2.

The staff concludes that the alternative actions, including the no-action alternative, may have environmental effects in at least some impact categories that reach MODERATE or LARGE significance.

8.4 References

10 CFR Part 50. Code of Federal Regulations, Title 10*, Energy,* Part 50, "Domestic Licensing of Production and Utilization Facilities."

10 CFR Part 51. Code of Federal Regulations, Title 10, *Energy*, Part 51, "Environmental Protection Regulations for Domestic Licensing and Related Functions."

10 CFR Part 52. Code of Federal Regulations, Title 10, *Energy,* Part 52, "Early Site Permits; Standard Design Certifications; and Combined Licenses for Nuclear Power Plants."

40 CFR Part 50. Code of Federal Regulations, Title 40, *Protection of Environment*, Part 50, "National Primary and Secondary Ambient Air Quality Standards."

40 CFR Part 51. Code of Federal Regulations, Title 40, *Protection of Environment*, Part 51, "Requirements for Preparation, Adoption, and Submittal of Implementation Plans."

40 CFR Part 60. Code of Federal Regulations, Title 40, *Protection of Environment*, Part 60, "Standards of Performance for New Stationary Sources."

40 CFR Part 81. Code of Federal Regulations, Title 40, *Protection of Environment*, Part 81, "Designation of Areas for Air Quality Planning Purposes."

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