8.0 Environmental Impacts of Alternatives to License Renewal

This chapter examines the potential environmental impacts associated with denying the renewal of an operating license (OL) (i.e., the no-action alternative); the potential environmental impacts from electric generation sources other than the Virgil C. Summer Nuclear Station (V.C. Summer); the possibility of purchasing electric power from other sources to replace power generated by V.C. Summer 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 V.C. Summer. The environmental impacts are evaluated using the U.S. Nuclear Regulatory Commission's (NRC) three-level standard of significance—SMALL, MODERATE, or LARGE—developed using the Council on Environmental Quality guidelines and set forth in the footnotes 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 category of environmental justice.

8.1 No-Action Alternative

The NRC's regulations implementing the National Environmental Policy Act of 1969 (NEPA) specify that the no-action alternative be discussed in an NRC environmental impact statement (EIS) [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 V.C. Summer OL, and

(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.

South Carolina Electric and Gas Company (SCE&G) would then decommission V.C. Summer when plant operations cease.

SCE&G will be required to comply with NRC decommissioning requirements whether or not the OL is renewed. If the V.C. Summer OL is renewed, decommissioning activities may be postponed for up to an additional 20 years. If the OL is not renewed, SCE&G would conduct decommissioning activities according to the requirements in 10 CFR 50.82.

The environmental impacts associated with decommissioning under both license renewal and 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 Supplement 1 to the *Final Generic Environmental Impact Statement on Decommissioning of Nuclear Facilities*, NUREG-0586 (NRC 2002). 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 of the no-action alternative are summarized in Table 8-1 and are discussed in the following paragraphs. Implementation of the no-action alternative would also have certain positive impacts in that adverse environmental impacts associated with current operation of V.C. Summer (e.g., solid waste impacts and adverse impacts on aquatic life) would be eliminated.

The no-action alternative is a conceptual alternative resulting in a net reduction in power production, but with no environmental impacts assumed for replacement power. In actual practice, the power lost by not renewing the V.C. Summer OL would likely be replaced by (1) demand-side management (DSM) and energy conservation, (2) power purchased from other electricity providers, (3) generating alternatives other than V.C. Summer, or (4) some combination of these options. This replacement power would produce additional environmental impacts as discussed in Section 8.2 of this report.

- **Land Use**

  Temporary changes in onsite land use could occur during decommissioning. Temporary changes may include addition or expansion of staging and laydown areas or construction of temporary buildings and parking areas. No offsite land-use changes are expected as a result of decommissioning. Following decommissioning, the V.C. Summer site would likely be retained by SCE&G for other corporate purposes. Eventual sale or transfer of land occupied by V.C. Summer, however, could result in changes to land use. Notwithstanding this possibility, the impacts of the no-action alternative on land use are considered SMALL.

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

Impact Category	Impact	Comment
Land Use	SMALL	Onsite impacts expected to be temporary. No offsite impacts expected.
Ecology	SMALL	Impacts to ecology are expected to be temporary and largely mitigatable using best management practices.
Water Use and Quality	SMALL	Water use will decrease. Water quality unlikely to be adversely affected unless onsite disposal of demolition debris is utilized.
Air Quality	SMALL	Greatest impact is likely to be from fugitive dust; impact can be mitigated by good management practices.
Waste	SMALL	Low-level radioactive waste will be disposed of in licensed facilities. A permanent disposal facility for high-level waste is not currently available.
Human Health	SMALL	Radiological doses to workers and members of the public are expected to be within regulatory limits and comparable to, or lower than, doses from operating plants. Occupational injuries are possible, but injury rates at nuclear power plants are below the U.S. average industrial rate.
Socioeconomics	SMALL to LARGE	Decrease in employment in Fairfield County and surrounding counties and tax revenues in Fairfield County.
Aesthetics	SMALL	Positive impact from eventual removal of buildings and structures. Some noise impact during decommissioning operations.
Historic and Archaeological Resources	SMALL	Minimal impact on land used during plant operations. Land occupied by V.C. Summer would likely be retained by SCE&G for other corporate purposes.
Environmental Justice	SMALL to MODERATE	Some loss of employment opportunities and social programs is expected.

- **Ecology**

  At V.C. Summer, impacts on aquatic ecology could result from removal or the filling of the intake structures discharge canal. Impacts to aquatic ecology would likely be short-term and could be mitigated. The aquatic environment is expected to recover naturally. Impacts on terrestrial ecology could occur as a result of land disturbance for additional laydown yards, stockpiles, and support facilities. Land disturbance is expected to be minimal and to result in relatively short-term impacts that can be mitigated using best management

practices (dust suppression and erosion control). The land is expected to recover naturally. Overall, the ecological impacts associated with decommissioning are considered SMALL.

- **Water Use and Quality**

  Cessation of plant operations would result in a reduction in water use because reactor cooling will no longer be required. As plant staff size decreases, the demand for potable water is expected to also decrease. Overall, water use and quality impacts of decommissioning are considered SMALL.

- **Air Quality**

  Decommissioning activities that can adversely affect air quality include dismantlement of systems and equipment, demolition of buildings and structures, and the operation of internal combustion engines. The most likely adverse impact would be the generation of fugitive dust. Best management practices, such as seeding and wetting, could be used to minimize the generation of fugitive dust. Overall, air quality impacts associated with decommissioning activities are considered SMALL.

- **Waste**

  Decommissioning activities would result in the generation of radioactive and nonradioactive waste. The volume of low-level radioactive waste (LLW) could vary greatly depending on the type and size of the plant, the decommissioning option chosen, and the waste treatment and volume reduction procedures used. LLW must be disposed of in a facility licensed by NRC or a state with authority delegated by NRC. Recent advances in volume reduction and waste processing have significantly reduced waste volumes.

  A permanent repository for high-level waste is not currently available. The NRC has made a generic determination that, if necessary, spent fuel generated in any reactor can be stored safely and without significant environmental impacts for at least 30 years beyond the licensed life for operation (which may include the term of a revised or renewed license) of that reactor in its spent fuel pool or at either onsite or offsite independent spent fuel storage installations [10 CFR 51.23(a)]. Overall, waste impacts associated with decommissioning activities are considered SMALL.

- **Human Health**

  Radiological doses to occupational workers during decommissioning activities are estimated to average approximately 5 percent of the dose limits in 10 CFR Part 20, and to be similar

to, or lower than, the doses experienced by workers in operating nuclear power plants. Collective doses to members of the public and to the maximally exposed individual as a result of decommissioning activities are estimated to be well below the limits in 10 CFR Part 20, and to be similar to, or lower than, the doses received from operating nuclear power plants. Occupational injuries to workers engaged in decommissioning activities are possible. However, historical injury and fatality rates at nuclear power plants have been lower than the average U.S. industrial rates. Overall, the human health impacts associated with decommissioning activities are considered SMALL.

- **Socioeconomics**

If V.C. Summer ceased operation at the end of its current OL, there would be a decrease in employment and tax revenues associated with the closure. Employment (primary and secondary) impacts and impacts on population would occur over a wide area. Employees working at V.C. Summer reside in a number of South Carolina counties; however, approximately 96 percent of employees live in Fairfield, Lexington, Newberry, and Richland Counties (SCE&G 2002). The no-action alternative would result in the loss of plant payrolls 20 years earlier than if the OL were renewed.

Tax-related impacts would occur in Fairfield County and, to a much lesser extent, to other surrounding counties. Property tax payments made by SCE&G to Fairfield County for V.C. Summer constitute about 41 percent to 50 percent of the county's total property tax revenues (SCE&G 2002). The no-action alternative would result in the loss of the taxes attributable to V.C. Summer. There could also be an adverse impact on housing values and the local nearby economy if V.C. Summer were to cease operations.

Both Chapter 7 of the GEIS and Supplement 1 to NUREG-0586 (NRC 2002) note that socioeconomic impacts would be expected as a result of the decision to close a nuclear power plant, and that the direction and extent of the overall impacts would depend on the state of the economy, the net change in workforce at the plant, and the changes in local government tax receipts. The socioeconomic impacts of decommissioning activities themselves are expected to be SMALL. Appendix J of Supplement 1 to NUREG-0586 (NRC 2002) shows that the overall socioeconomic impact of plant closure plus decommissioning could be greater than SMALL.

The staff has concluded that when the property tax revenue from a nuclear power plant comprises over 20 percent of the tax revenue of a local jurisdiction, the socioeconomic impacts associated with the loss of the plant's tax revenue as a result of plant closure is considered LARGE. The property taxes that SCE&G pays for V.C. Summer comprises

more than 40 percent of total revenue of Fairfield County; consequently, the socioeconomic impacts resulting from loss of this revenue are considered LARGE.

SCE&G employees working at V.C. Summer currently contribute time and money toward community involvement, including school, churches, charities, and other civic activities. It is likely that, with a reduced presence in the community following decommissioning, community involvement efforts by SCE&G and its employees in the region would be less.

- **Aesthetics**

Decommissioning would result in the eventual dismantlement of buildings and structures at the site resulting in a positive aesthetic impact. Noise would be generated during decommissioning operations that might be detectable offsite; however, the impact is unlikely to be of moderate or large significance. Overall, the aesthetic impacts associated with decommissioning are considered SMALL.

- **Historic and Archaeological Resources**

The amount of undisturbed land needed to support the decommissioning process will be relatively small. Activities conducted within operational areas are not expected to have a detectable effect on important cultural resources because these areas have been impacted during the operating life of the plant. Minimal disturbance of land outside the licensee's operational area for decommissioning activities is expected. Historic and archaeological resources on undisturbed portions of the site are not expected to be adversely affected. Following decommissioning, the site would likely be retained by SCE&G for other corporate purposes. Eventual sale or transfer of the site, however, could result in adverse impacts to cultural resources if the land-use pattern changes dramatically. Notwithstanding this possibility, the impacts of the no-action alternative on historic and archaeological resources are considered SMALL.

- **Environmental Justice**

Current operations at V.C. Summer have no disproportionate impacts on the minority and low-income populations of Fairfield County and surrounding counties. It is evident from staff research and consultations with local officials that Fairfield and Newberry Counties have benefitted from V.C. Summer in ways that contra-act and mitigate negative socioeconomic trends. Closure of V.C. Summer would result in decreased employment opportunities and tax revenues in Fairfield County and surrounding counties, with possible negative and

disproportionate impacts on minority or low-income populations. Therefore, because V.C. Summer is located at the expanding boundary of the Columbia Metro Area with many employment opportunities, the environmental justice impacts under the no-action alternative are considered SMALL to MODERATE.

8.2 Alternative Energy Sources

This section discusses the environmental impacts associated with alternative sources of electric power to replace the power generated by V.C. Summer, assuming that the OL is 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 power generation at the V.C. Summer site and at an alternate South Carolina/greenfield site[(a)] (Section 8.2.1),
- natural gas-fired power generation at the V.C. Summer site and at an alternate South Carolina/greenfield site (Section 8.2.2), and
- nuclear power generation at the V.C. Summer site and at an alternate South Carolina/greenfield site (Section 8.2.3).

The alternative of purchasing power from other sources to replace power generated at V.C. Summer 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 V.C. Summer 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, issues an Annual Energy Outlook. The latest report, *Annual Energy Outlook 2002*, was issued in December 2001 (DOE/EIA 2001a). In this report, EIA projects that combined-cycle[(b)] 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-

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

cycle technology can also be 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 United States 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 United States 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 V.C. Summer 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. 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). The submission to the NRC of these three applications for certification indicates continuing interest in the possibility of licensing new nuclear power plants. In addition, the staff expects to receive up to three early site permit applications under 10 CFR Part 52 Subpart A in 2003, further indicating continued interest in building and operating nuclear power facilities. NRC has established a New Reactor Licensing Project Office to prepare for and manage future reactor and site licensing applications (NRC 2001).

V.C. Summer has a maximum net electrical output of 966 MW(e). For the coal and natural gas alternatives, SCE&G assumes two standard units in its Environmental Report (ER) (SCE&G 2002), each a maximum 408-MW(e) net electrical output. This approach is followed in this SEIS, although it results in some environmental impacts that are roughly 16 percent lower than if full replacement capacity were constructed. Although customized unit sizes can be built, use of standardized sizes is more economical. In addition, using three 408-MW(e) units for the

(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.

analysis would overestimate environmental impacts and tend to make the fossil alternatives less attractive.

For purposes of analysis, SCE&G identified Cope Station near Bamberg, South Carolina, as the location for the coal-fired alternative (SCE&G 2002). Cope Station is the site of a new state-of-the-art coal-fired unit. Similarly, for purposes of analysis, SCE&G identified the V.C. Summer site as the location for the gas-fired alternative. This SEIS has been prepared taking account of these preferred and potential sites, but the analyses were not limited to these particular sites.

8.2.1 Coal-Fired Power Generation

The coal-fired alternative is analyzed for both V.C. Summer and an alternate site in South Carolina. As discussed in Section 8.2, the staff assumed construction of two 408-MW(e) units. Co-location with an existing coal-fired unit would preclude the need to construct additional transmission lines and other facilities needed to support coal-fired units.

Coal and lime or limestone for a coal-fired plant sited at V.C. Summer most likely would be delivered via the existing rail line. Lime[(a)] or limestone is used in the scrubbing process for control of sulfur dioxide (SO_2) emissions. Rail delivery also would be the most likely option for delivering coal and lime/limestone to an alternative site for the coal-fired plant. 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 alternative site could necessitate the construction of a new transmission line to connect to existing lines and a rail spur to the plant.

The coal-fired plant would consume approximately 2.4 million MT (2.60 million tons) per year of pulverized bituminous coal with an ash content of approximately 8.8 percent (SCE&G 2002). SCE&G assumes a heat rate of 3.0 J of fuel /J of electricity (10,200 Btu/kWh) and a capacity factor[(b)] of 0.85 in its ER (SCE&G 2002). After combustion, 99.9 percent of the ash (approximately 209,000 MT/yr [230,000 tons/yr]) would be collected and disposed of at the plant site. In addition, approximately 154,000 MT (170,000 tons) of scrubber sludge would be disposed of at the plant site based on annual lime usage of approximately 86,000 MT (95,000 tons).

(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 and is removed in sludge form.

(b) 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.

Unless otherwise indicated, the assumptions and numerical values used in Section 8.2.1 are from the SCE&G ER (SCE&G 2002). 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 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 V.C. Summer would use the existing once-through cooling system. The staff also assumed that a greenfield site would use a once-through cooling system. In Section 8.2.1.2 of this SEIS, the staff discusses the environmental impact differences between closed-cycle and once-through cooling systems.

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 South Carolina/greenfield site would depend on the location of the particular site selected.

- **Land Use**

  The V.C. Summer site is approximately 909 ha (2245 ac). Construction of the power block and coal storage area would impact some land area and associated terrestrial habitat. The existing facilities and infrastructure at V.C. Summer 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 cooling system, switchyard, offices, rail spur, and transmission line rights-of-way.

  The coal-fired generation alternative would necessitate converting some of the unused land at V.C. Summer to coal storage and ash scrubber sludge disposal. SCE&G estimates that ash and scrubber waste disposal over a 40-year plant life would require approximately 85 ha (210 ac) (SCE&G 2002). There is sufficient space at V.C. Summer to accommodate the coal-fired plant (about 560 ha [1390 ac] based on estimates in the GEIS [NRC 1996]) and the waste disposal area. After closure, the waste site would be re-vegetated and the land would become available for other uses. Additional land-use changes would occur offsite in an undetermined coal-mining area to supply coal for the plant. In the GEIS, the staff 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). Partially offsetting this offsite land use would be the elimination of the need for uranium mining to supply fuel for V.C. Summer.

Table 8-2. Summary of Environmental Impacts of Coal-Fired Generation at V.C. Summer Site and an Alternate Greenfield Site Using Once-Through Cooling

	V.C. Summer Site		Alternate Greenfield Site	
Impact Category	**Impact**	**Comments**	**Impact**	**Comments**
Land Use	SMALL to MODERATE	Use of existing infrastructure. Uses about 560 ha (1390 ac) for plant, waste disposal of coal ash and scrubber sludge over 40-year plant life. Additional offsite land impacts for coal and limestone mining.	SMALL to LARGE	Uses approximately 860 ha (1390 ac), for plant, offices, parking and waste disposal; additional land impacts for coal and limestone mining; possible impacts for transmission line and rail spur. Degree of impact dependent on whether alternative site is disturbed: SMALL to MODERATE impact to previously developed site; LARGE impact to greenfield site.
Ecology	SMALL to MODERATE	Uses mainly previously disturbed areas at current V.C. Summer site, plus rail corridor. However, some additional areas at the site will be affected.	SMALL to LARGE	Impact depends whether site is previously developed (SMALL to MODERATE) or greenfield (MODERATE to LARGE). Factors to consider include location and ecology of site, surface water body used for intake and discharge, and transmission line and/or rail spur route; potential habitat loss and fragmentation; reduced productivity and biological diversity.
Water Use and Quality	SMALL	Once-through cooling would use existing intake structures; surface water use should remain the same as current uses for V.C. Summer.	SMALL to MODERATE	Impact will depend on the volume of water withdrawn and discharged and the characteristics of the surface water body.
Groundwater Use and Quality	SMALL	Groundwater not used, remaining the same as currently for V.C. Summer.	SMALL	Groundwater use similar to impacts at V.C. Summer; impacts depend on groundwater use and availability.

Table 8-2. Summary of Environmental Impacts of Coal-Fired Generation at V.C. Summer Site and an Alternate Greenfield Site Using Once-Through Cooling (continued)

	V.C. Summer Site		Alternate Greenfield Site	
Impact Category	**Impact**	**Comments**	**Impact**	**Comments**
Air Quality	MODERATE	Sulfur oxides • 5669 MT/yr (6249 tons/yr) Nitrogen oxides • 582 MT/yr (642 tons/yr) Particulates • 102 MT/yr (113 tons/yr) of total suspended particulates which would include 24 MT/yr (26 tons/yr) of PM_{10}. Carbon monoxide • 582 MT/yr (642 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 V.C. Summer site, although pollution-control standards may vary.
Waste	MODERATE	Total waste volume would be approximately 363,000 MT/yr (400,000 tons/yr) of ash and scrubber sludge requiring approximately 85 ha (210 ac) for disposal during the 40-year life of the plant.	MODERATE	Air Quality
Human Health	SMALL	Impacts are uncertain, but considered SMALL in the absence of more quantitative data.	SMALL	

Table 8-2. Summary of Environmental Impacts of Coal-Fired Generation at V.C. Summer Site and an Alternate Greenfield Site Using Once-Through Cooling (continued)

	V.C. Summer Site		Alternate Greenfield Site	
Impact Category	**Impact**	**Comments**	**Impact**	**Comments**
Socioeconomics	SMALL to LARGE	During construction, impacts would be SMALL to MODERATE. Up to 2500 additional workers during the peak period of the 5-year construction period, followed by reduction from current V.C. Summer work force of 740 to 70. Tax base preserved. Impacts during operation would be SMALL to MODERATE. Transportation impacts associated with construction workers could be MODERATE to LARGE. Transportation impacts during operation would be SMALL due to decreased work force. For rail transportation of coal and lime/limestone, the impact is considered SMALL to MODERATE.	SMALL to LARGE	Construction impacts depend on location, but could be LARGE if plant is located in a rural area. Fairfield County would experience loss of tax base and employment with potentially LARGE impacts. Impacts during operation at alternative site would be SMALL to LARGE, depending upon the economy at the alternate site. Transportation impacts associated with construction workers could be MODERATE to LARGE. Transportation impacts during operation would be SMALL. For rail transportation of coal and lime/limestone, the impact is considered SMALL to MODERATE. For barge transportation, the impact is considered SMALL.
Aesthetics	SMALL to MODERATE	Two coal-fired power plant units and exhaust stack would be visible in daylight hours from offsite. Outside lighting at the plant would also be visible at night. Rail transportation of coal and lime/limestone would also have a MODERATE impact. Mechanical sources of noise would be audible offsite. These impacts are SMALL to MODERATE.	SMALL to LARGE	Impact would depend on the site selected and the surrounding land features and could be LARGE if a greenfield site is selected. If needed, a new transmission line or rail spur would add to aesthetic impact. Rail transportation of coal and lime/limestone would be SMALL to MODERATE, depending on the characteristics of the alternative site.

Table 8-2. Summary of Environmental Impacts of Coal-Fired Generation at V.C. Summer Site and an Alternate Greenfield Site Using Once-Through Cooling (continued)

	V.C. Summer Site		Alternate Greenfield Site	
Impact Category	**Impact**	**Comments**	**Impact**	**Comments**
Historic and Archeological Resources	SMALL to MODERATE	Some construction would affect previously developed parts of V.C. Summer; cultural resource inventory should minimize any impacts on undeveloped lands. Studies would likely be needed to identify, evaluate, and address mitigation of the potential impacts of new plant construction on undeveloped sites on cultural resources even at a developed site.	SMALL to MODERATE	Alternate location would necessitate cultural resource studies. Studies would likely be needed to identify, evaluate, and address mitigation of the potential impacts of new plant construction on undeveloped sites on cultural resources.
Environmental Justice	SMALL to 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 600 operating jobs (permanent and contractor) at V.C. Summer could reduce employment prospects for minority and low-income populations. Dependent, to some extent, on the economic growth of Columbia and surrounding area.	SMALL to LARGE	Impacts at alternate site will vary depending on population distribution and makeup. Could be SMALL to LARGE. Fairfield County would lose significant revenue, which could have MODERATE to LARGE impacts on minority and low-income populations in terms of services the County could provide with the smaller property tax and employment base.

The GEIS states that approximately 405 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).

The impact of a coal-fired generating unit on land use at V.C. Summer is best characterized as SMALL to MODERATE. The impact would definitely be greater than the OL renewal alternative.

In the GEIS, the staff estimated that a 1000-MW(e) coal-fired plant would require approximately 700 ha (1700 ac) (NRC 1996). Construction of a 816-MW(e) coal-fired

generation alternative at an alternative site could impact proportionately less land (about 560 ha [1390 ac]). The degree to which the land use would be impacted depends on whether the alternative site is a greenfield site or a previously developed industrial site (such as Cope Station). Additional land could be needed for a transmission line and a rail spur to the plant site. Depending on transmission line and rail line routing requirements, this alternative would result in SMALL to LARGE land-use impacts.

- **Ecology**

Locating a coal-fired plant at V.C. Summer would alter ecological resources because of the need to convert approximately 85 ha (210 ac) (SCE&G 2002) for ash and scrubber sludge disposal. In addition, construction of the power block and coal storage area would impact about 475 ha (1190 ac) and associated habitat. Some of this area would have been previously disturbed. Operation of the coal-fired plant would use the existing cooling system, which would have adverse impacts to aquatic resources. In summary, because the coal-fired alternative is developed on a mainly previously disturbed area, is at an existing industrial site, and makes maximum use of existing facilities, it is expected that the ecological impacts would be SMALL to MODERATE, but still greater than renewal of the V.C. Summer OL.

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. Once-through cooling water withdrawal and discharge could have adverse aquatic resource impacts. If needed, construction and maintenance of the transmission line and a rail spur would have ecological impacts. Overall, the ecological impacts at an alternate site would be SMALL to MODERATE (previously developed site) or MODERATE to LARGE (greenfield site).

- **Water Use and Quality**

Surface water. The coal-fired generation alternative at V.C. Summer is assumed to use the existing once-through system, which would minimize incremental water-use and quality impacts. Thus 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.

For a coal-fired plant located at an alternate site, the impact on the surface water would depend on the volume of water needed for make-up water, 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 of South Carolina. The impacts would be SMALL to MODERATE.

Groundwater. The staff assumed that the two groundwater removal wells would continue to be used to alleviate water seepage into the below-grade portions of coal-fired plant buildings located at V.C. Summer. Groundwater withdrawals would be equal to or less than the no-action and license renewal alternatives. Hence, impacts are considered SMALL. Use of groundwater for a coal-fired plant located at an alternative site is a possibility. Groundwater withdrawals at an alternative site would likely require a permit from the State of South Carolina. The impacts are considered SMALL.

- **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.

V.C. Summer is located within the Columbia Intrastate Air Quality Control Region (40 CFR 81.108). The air quality in this region is designated as better than national standards, in attainment, or unclassified for all criteria pollutants, in 40 CFR 81.341. However, on August 23, 2002, the South Carolina Department of Health and Environmental Control (SCDHEC) published a "Notice of Drafting" in the State Register for an Early Action Plan for measures to attain the 8-hour standard prior to any non-attainment designation. The State intends to implement control measures in anticipation of future U.S. Environmental Protection Agency (EPA) actions.

A new coal-fired generating plant located in V.C. Summer would likely need a prevention of significant deterioration permit and an operating permit under the Clean Air Act. The plant would need to comply with the new source performance standards for such 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 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. The air quality in this region is designated as better than national standards, in attainment, or unclassified for all criteria pollutants, in 40 CFR 81.341.

Section 169A of the Clean Air Act (42 USC 7491) establishes a national goal of preventing future and remedying existing impairment of visibility in mandatory Class I Federal areas when impairment results from human-made air pollution. EPA issued a new regional haze rule on July 1, 1999, cited in the *Federal Register* (FR) as 64 FR 35714 (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 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 Federal area, additional air pollution control requirements could be imposed.

South Carolina has only one area (Cape Romaine Wildlife Area) designated in 40 CFR 81.426 as a mandatory Class I Federal area in which visibility is an important value. This Class I Federal area is not within 80 km (50 mi) of V.C. Summer.

In 1998, the EPA issued a rule requiring 22 eastern states, including South Carolina, to revise their state implementation plans to reduce NO_x emissions. Nitrogen oxide emissions contribute to violations of the national ambient air quality standard for ozone. The total amount of NO_x that can be emitted by each of the 22 states in the year 2007 ozone season (May 1 to September 30) is set out at 40 CFR 51.121(e). For South Carolina, the amount is 111,656 MT (123,105 tons). Any new coal-fired plant sited in South Carolina would be subject to this limitation.

Impacts for particular pollutants are as follows:

Sulfur oxides emissions. SCE&G states in its ER that an alternative coal-fired plant located at Cope Station would use dry scrubber-calcium hydroxide for flue gas desulfurization (SCE&G 2002).

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. The 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.

SCE&G estimates that by using the best technology to minimize SO_x emissions, the total annual stack emissions would be approximately 5669 MT (6249 tons) of SO_x (SCE&G 2002).

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 at 40 CFR 60.44a(d)(1). This regulation, issued on September 16, 1998 (63 FR 49453 [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.

SCE&G 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 582 MT (642 tons) (SCE&G 2002). This level of NO_x emissions would be greater than the OL renewal alternative.

Particulate emissions. SCE&G estimates that the total annual stack emissions would include 102 MT (113 tons) of filterable total suspended particulates (particulates that range in size from less than 0.1 µm up to approximately 45 µm). The 102 MT (113 tons) would include 24 MT (26 tons) of PM_{10} (particulate matter having an aerodynamic diameter less than or equal to 10 µm). 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. SCE&G estimates that the total carbon monoxide emissions would be approximately 582 MT (642 tons) per year (SCE&G 2002). This level of emissions is greater than the OL renewal alternative.

Hazardous air pollutants 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 2000a]). The 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 2000a). The EPA concluded that mercury is the hazardous air pollutant of greatest concern. The 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., the developing fetus 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 2000a). 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 2000a).

Uranium and thorium. 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).

Summary. The GEIS analysis did not quantify emissions from coal-fired power plants, but implied that air-quality 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 V.C. Summer would not significantly change the air-quality impacts identified in this section, 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 catalyst, additional ash, and scrubber sludge. Two 408-MW(e) coal-fired plants would generate approximately 363,000 MT

(400,000 tons) of this waste annually for 40 years. The waste would be disposed of onsite, accounting for approximately 85 ha (210 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 also be generated during construction activities.

In May 2000, the EPA issued a Notice of Regulatory Determination on Wastes From the Combustion of Fossil Fuels (EPA 2000b). The 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 damages 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 percent 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, the EPA announced its intention to issue regulations for disposal of coal combustion waste under subtitle D of the Resource Conservation and Recovery Act of 1976 (RCRA) (42 USC 6901).

For these 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 V.C. Summer 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 fuel and limestone mining and worker and public risks from fuel and lime/limestone transportation and 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.

The staff stated in the GEIS that there could be human health impacts (cancer and emphysema) from inhalation of toxins and particulates, 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 the 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 previously discussed, the EPA has recently concluded that certain segments of the United States population (e.g., the developing fetus 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 and operation. Construction of the coal-fired alternative would take approximately five years. The staff assumed that construction would take place while V.C. Summer continues operation and would be completed by the time V.C. Summer permanently ceases operations. The work force would be expected to vary between 1200 and 2500 workers during the five-year construction period (NRC 1996). These workers would be in addition to the approximately 740 workers employed at V.C. Summer. During construction of the new coal-fired plant, communities near V.C. Summer would experience demands on housing and public services that could have SMALL to MODERATE impacts. These impacts would be tempered by construction workers commuting to the site from outside the immediate area of the site, including Columbia, South Carolina. After construction, the communities would be impacted by the loss of the construction jobs.

If the coal-fired replacement plant were constructed at V.C. Summer and the nuclear unit were decommissioned, there would be a loss of approximately 670 permanent and contract employees, as SCE&G estimates that the completed coal-fired plant would employ approximately 70 workers (SCE&G 2002). There would be 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 unit. For all of these reasons, the appropriate characterization of nontransportation socioeconomic impacts for a coal-fired plant constructed at V.C. Summer would be SMALL to MODERATE; the socioeconomic impacts would be noticeable, but would be unlikely to destabilize the area. The impacts could be mitigated by the site's proximity to the Columbia metropolitan area and might be additionally

offset if economic growth in Columbia and surrounding areas continued as it has during the last decade.

Construction of a replacement coal-fired power plant at an alternate site would relocate some socioeconomic impacts, but would not eliminate them. Fairfield County would experience the brunt of V.C. Summer operational job loss and would lose a significant tax base. These losses could have potentially LARGE socioeconomic impacts to the County, particularly over the short to intermediate term (from 5 to 10 years following plant closure), Communities around the new site would have to absorb the impacts of a large, temporary work force (up to 2500 workers at the peak of construction) and a permanent work force of approximately 70 workers. The staff stated in the GEIS that socioeconomic impacts at a rural site would be larger than at an urban site because more of the peak construction work force would need to move to the area to work. Alternative sites would need to be analyzed on a case-by-case basis. Socioeconomic impacts at or near an urban, previously developed industrial area would be SMALL. Socioeconomic impacts at a rural site would be MODERATE to LARGE, depending on the relative location of the site to towns and cities that might be able to accommodate such impacts.

Transportation. During the five-year construction period of replacement coal-fired units, up to 2500 construction workers would be working at the site in addition to the 740 workers at V.C. Summer. The addition of these workers could place significant traffic loads on existing highways near V.C. Summer. 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 70. The current V.C. Summer work force is approximately 740. 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 V.C. Summer operations.

Coal and lime/limestone would likely be delivered to V.C. Summer by trains. Each train would have approximately 115 open-top rail cars, each holding about 90 MT (100 tons) of coal. Additional cars would be needed for lime/limestone delivery. In all, approximately 224 trains per year would deliver the coal and lime/limestone for the two units. An average of roughly nine train trips per week would be needed to transport the coal and lime/limestone. For each full train delivery, an empty train would return. On several days per week, there would be two to three trains per day using the rail spur to V.C. Summer. Socioeconomic impacts associated with rail transportation, such as delays at rail crossings, would likely be SMALL to MODERATE.

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 due to a smaller work force.

At an alternate site, coal and lime/limestone delivery would likely be by rail, although barge delivery would be feasible at a coastal location. Impacts of rail transportation would be SMALL in a rural area and MODERATE in a more crowded suburban area. Barge delivery of coal and lime/limestone would likely have SMALL socioeconomic impacts.

- **Aesthetics**

The two coal-fired power plant units would be visible in daylight hours from offsite. The exhaust stack would be about 160 m (525 ft) high. The stack would be visible for several miles in every direction during daylight hours. The units and associated stacks would also be visible at night because of outside lighting. Visual impacts could be mitigated by landscaping and color selection for buildings that are consistent with the environment. Visual impact at night could be mitigated by reduced use of lighting and appropriate use of shielding or directional lighting.

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 delivery, use of outside loudspeakers, and the commuting of plant employees. The incremental noise impacts of a coal-fired plant compared to existing V.C. Summer operations are considered to be SMALL to MODERATE.

At an alternate site, there would be an aesthetic impact from the buildings and exhaust stacks. This impact could be LARGE if a greenfield site is used. There would also be an aesthetic impact if construction of a new transmission line and/or rail spur were 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. In a more suburban location, the impacts are considered MODERATE. This is due to the frequency of train transport, the fact that many people are likely to be within hearing distance of the rail route, and the impacts of noise on residents in the vicinity of the facility and the rail line. At a more rural location, the impacts could be SMALL. Noise and light from the plant would be detectable offsite. Overall, the

aesthetic impacts associated with locating at an alternative site can be categorized as SMALL to LARGE, depending on the characteristics of the alternative site.

- **Historic and Archaeological Resources**

  At the V.C. Summer 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 the V.C. Summer site 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 corridors, rail lines, or other rights-of-way). Historic and archaeological resource impacts need to be evaluated on a site-specific basis. The impacts can generally be effectively managed, and as such, impacts would vary between SMALL to MODERATE, depending on what historic and archaeologic resources are present, and whether mitigation is necessary.

- **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 V.C. Summer site. Some impacts on housing availability and prices during construction might occur, and this could disproportionately affect the minority and low-income populations to the extent housing frequented by these populations could come into increased demand. Closure of V.C. Summer would result in a decrease in employment of approximately 600 permanent and contract employees at the site. Resulting economic conditions could reduce employment prospects for minority or low-income populations. Overall, impacts would be SMALL to MODERATE, and may be mitigated by the economic vitality/expansion of the Columbia metropolitan and surrounding area.

  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 alternative site, Fairfield County would experience a loss of tax revenue that could affect their ability to provide services and programs. Fairfield County and surrounding counties would also lose

670 jobs. These impacts would be MODERATE to LARGE. Impacts at the alternative site would vary between SMALL and LARGE, depending on population makeup and distribution and the economy.

8.2.1.2 Closed-Cycle Cooling System

This section discusses the environmental impacts of constructing a coal-fired generation system at an alternate location site using a closed-cycle cooling system with cooling towers. The impacts (SMALL, MODERATE, or LARGE) of this option are the same as the impacts for a coal-fired plant using the once-through cooling system. However, there are some environmental impact differences between the closed-cycle and once-through cooling systems. Table 8-3 summarizes the incremental differences.

8.2.2 Natural Gas-Fired Power Generation

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

V.C. Summer is not served by natural gas pipelines. A dedicated, 0.6-m- (2-ft-) diameter pipeline would have to be constructed to V.C. Summer from Aiken, South Carolina, a distance of about 113 km (70 mi). The pipeline right-of-way would require 298 ha (737 ac).[(a)]

The staff assumed that a replacement natural gas-fired plant would use combined-cycle technology (SCE&G 2002). 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.

If a new natural gas-fired plant were built at an alternate site from V.C. Summer, a new transmission line may be needed to connect to existing lines. In addition, construction or upgrade of a natural gas pipeline from the plant to a supply point where an adequate and reliable supply of gas would be available also may be required.

The following additional assumptions are made for the natural gas-fired plants (SCE&G 2002):

- two 408-MW(e) net electrical units would be needed, each consisting of a 135-MW combustion turbine and a 138-MW heat recovery boiler,

(a) Calculated as follows: 70 mi x 100 ft easement = 298 ha or 737 ac.

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

Impact Category	Change in Impacts from Closed-Cycle Cooling System
Land Use	10 to 12 additional ha (25 to 30 ac) required for cooling towers and associated infrastructure.
Ecology	Impact would depend on ecology at the site. Additional impact to terrestrial biota 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. 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 plume. 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.

- natural gas with an average heating value of 37 MJ/m^3 (1037 Btu/ft^3) will be the primary fuel, and

- natural gas consumption will be 1.4 billion m^3/yr (50 billion ft^3/yr).

Unless otherwise indicated, the assumptions and numerical values used in Section 8.2.2 are from the SCE&G ER (SCE&G 2002). 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 site will depend on the location of the particular site selected.

Table 8-4. Summary of Environmental Impacts of Natural Gas-Fired Generation at V.C. Summer and an Alternate Greenfield Site Using Once-Through Cooling

	V.C. Summer Site		Alternate Greenfield Site	
Impact Category	**Impact**	**Comments**	**Impact**	**Comments**
Land Use	SMALL to MODERATE	45 ha (110 ac) of previously disturbed land needed for plant site. Additional impact of up to approximately 295 ha (729 ac) for construction of an underground gas pipeline. Maximum use of existing infrastructure at the site.	SMALL to LARGE	SMALL if infrastructure is in place, 45 ha (110 ac) for powerblock, offices, roads, and parking areas. MODERATE if additional land needed for transmission line and/or natural gas pipeline. LARGE if greenfield site and transmission lines required.
Ecology	SMALL to LARGE	Uses some undeveloped areas at V.C. Summer site, plus gas pipeline.	SMALL to LARGE	Impact depends on greenfield or previously developed site. Also impact depends on biota 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.
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.
Groundwater Use and Quality	SMALL	Groundwater not used, remaining the same as currently for V.C. Summer.	SMALL	Groundwater use similar to impacts at V.C. Summer; impacts depend on groundwater use and availability.

Table 8-4. Summary of Environmental Impacts of Natural Gas-Fired Generation at V.C. Summer and an Alternate Greenfield Site Using Once-Through Cooling (continued)

	V.C. Summer Site		Alternate Greenfield Site	
Impact Category	**Impact**	**Comments**	**Impact**	**Comments**
Air Quality	MODERATE	Sulfur oxides • 80 MT/yr (88 tons/yr) Nitrogen oxides • 301 MT/yr (332 tons/yr) Carbon monoxide • 395 MT/yr (435 tons/yr) PM_{10} particulates • 118 MT/yr (130 tons/yr) Some hazardous air pollutants.	MODERATE	Same emissions as V.C. Summer site.
Waste	SMALL	Small amount of ash produced.	SMALL	Small amount of ash produced.
Human Health	SMALL	Impacts considered to be minor.	SMALL	Impacts considered to be minor.
Socioeconomics	SMALL to MODERATE	During construction, impacts would be SMALL to MODERATE. Up to 1200 additional workers during the peak of the three-year construction period, followed by reduction from current V.C. Summer work force of 740 to 150; tax base preserved. Impacts during operation would be SMALL to MODERATE, due to loss of employment in Fairfield County and surrounding counties, which may be offset by proximity to Columbia economy. Transportation impacts associated with construction workers would be SMALL to MODERATE.	SMALL to LARGE	Impact depends on site characteristics. During construction, impacts on receiving county could be SMALL to MODERATE. Up to 1200 additional workers during the peak of the three-year construction period. Fairfield County would experience loss of V.C. Summer tax base. Fairfield County and surrounding counties would experience loss of employment with potentially MODERATE to LARGE associated impacts. Transportation impacts associated with construction workers would be SMALL to LARGE.
Aesthetics	SMALL	Some visibility of structures offsite.	SMALL to LARGE	Impact would depend on the site selected and the surrounding land features. SMALL if previously developed site and site disturbance minimal. MODERATE to LARGE if a greenfield site is selected.

Table 8-4. Summary of Environmental Impacts of Natural Gas-Fired Generation at V.C. Summer and an Alternate Greenfield Site Using Once-Through Cooling (continued)

	V.C. Summer Site		Alternate Greenfield Site	
Impact Category	**Impact**	**Comments**	**Impact**	**Comments**
Historic and Archeological Resources	SMALL to MODERATE	Some construction would affect previously developed parts of V.C. Summer; cultural resource inventory should minimize any impacts on undeveloped lands. Studies would likely be needed to identify, evaluate, and address mitigation of the potential impacts of new plant construction on undeveloped sites on cultural resources even at a developed site. Any potential impacts can likely be effectively managed.	SMALL to MODERATE	Alternate location would necessitate cultural resource studies. Studies would likely be needed to identify, evaluate, and address mitigation of the potential impacts of new plant construction on undeveloped sites on cultural resources.
Environmental Justice	SMALL to 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 590 operating jobs at V.C. Summer could reduce employment prospects for minority and low-income populations. Proximity to Columbia may mitigate impacts.	SMALL to LARGE	Impacts at alternate site vary depending on population distribution and makeup at site could be SMALL to LARGE. Fairfield County would lose significant revenue, which could have MODERATE to LARGE impacts on minority and low-income populations. Proximity to Columbia may mitigate impacts.

- **Land Use**

For siting at V.C. Summer, 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 once-through cooling system, switchyard, offices, and transmission line right(s)-of-way. Much of the land that would be used has been previously disturbed. In the GEIS, staff estimated that 45 ha (110 ac) are needed for a natural gas-fired plant site (NRC 1996). At V.C. Summer, this much previously disturbed land is available within the boundaries of the plant site (SCE&G 2002). There would be an additional impact of up to approximately 295 ha (729 ac) for construction of a natural gas pipeline to the V.C. Summer site (SCE&G 2002). SCE&G states that it would apply best management practices during

construction of the pipeline such as minimizing soil loss and constructing the pipeline along existing utility corridors, if possible (SCE&G 2002). Land-use impacts at V.C. Summer would be SMALL to MODERATE and depend on the extent to which ecological damage could be minimized in the construction of the natural gas pipeline.

For construction at an alternate site, the staff assumed that 45 ha (110 ac) would be needed for the plant and associated infrastructure (NRC 1996). A previously developed site with substantial infrastructure in place (e.g., gas line and transmission line), would be characterized as having SMALL impacts. For any new natural gas plant, additional land could be impacted for construction of a transmission line and/or natural gas pipeline to serve the plant, in which case the impacts could be MODERATE. Land use impacts at a greenfield site could be considered LARGE.

Offsite of V.C. Summer or alternative site, additional land would be required for natural gas wells and collection stations. NRC staff estimated in the GEIS that approximately 1500 ha (3600 ac) would be needed for a 1000-MW(e) plant. A replacement gas-fired plant for V.C. Summer would be 816 MW(e) and would affect proportionately less land. Partially offsetting these offsite land requirements would be the elimination of the need for mining the uranium and processing it during the operating life of a 1000-MW(e) nuclear power plant. The staff estimated 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. Because the two assumed replacement units for V.C. Summer would generate 408 MW(e) each, the land needed for gas wells and collection stations (and the land not needed for nuclear fuel) would be proportionately lower. Overall, land-use impacts would be MODERATE to LARGE.

- **Ecology**

At the V.C. Summer site, there would be ecological, land-related impacts for siting of the gas-fired plant; however the impacts would be SMALL considering the smaller footprint of the new facility (compared to the existing nuclear facilities) and the fact that the land at the site is previously disturbed. There would be ecological impacts associated with bringing a new gas pipeline to V.C. Summer. Impacts would include losses of less mobile animals such as mice, which are common throughout the area. Aquatic impacts could include habitat disturbance at stream crossings, removal of shading vegetation, and erosion and sedimentation. Habitat of State- or Federal-listed mussel species might be affected. Noise and movement from workers would also disturb wildlife. SCE&G expects the impacts to be minor and temporary (SCE&G 2002). Overall, the ecological impacts are considered SMALL to LARGE.

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. At a greenfield site, construction of a transmission line and a gas pipeline to serve the plant could be expected to have ecological impacts. Whether these impacts are temporary or permanent and the extent to which ecological resources are impacted is highly dependent on the location of the alternative site. Ecological impacts resulting from plant siting and utility easements could include impacts on threatened or endangered species. There could be wildlife habitat loss and reduced productivity, habitat fragmentation, and a local reduction in biological diversity. Once-through cooling water withdrawal and discharge could have aquatic resource impacts. Aquatic impacts could include habitat disturbance at stream crossings, removal of shading vegetation, and erosion and sedimentation. Habitat of State- or Federal-listed mussel species might be affected. Hence, at a greenfield site the ecological impacts are expected to be MODERATE to LARGE. If the alternative site selected already has been developed, then the terrestrial ecological impacts would be SMALL if the required infrastructure is already in place. Aquatic impacts would be SMALL to MODERATE, depending on the site location and aquatic habitats affected. Overall, the ecological impacts at an alternative site are considered SMALL to LARGE, depending on the characteristics of the site selected.

- **Water Use and Quality**

Surface water. The gas-fired plant sited at V.C. Summer is assumed to use the existing once-through cooling system. Each of the 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. Overall, water use and quality impacts at V.C. Summer are considered SMALL as operation impacts are minimized by use of the existing intake/discharge system. Water quality impacts from sedimentation during construction of a natural gas-fired plant is characterized by the staff in the GEIS as SMALL (NRC 1996). The staff also notes that operational water quality impacts would be similar to, or less than, those from other generating technologies.

For alternative sites, the impacts on the surface water would depend on the volume of water needed for makeup water, 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 of South Carolina. Water use and quality impacts at an alternative site are considered SMALL to MODERATE, depending on the characteristics of the alternative site.

Groundwater. The staff assumed that the two groundwater removal wells would continue to be used to alleviate water seepage into the below-grade portions of buildings located at V.C. Summer. Groundwater withdrawals would be equal to the no-action and license

renewal alternatives. Hence, impacts are considered SMALL. Use of groundwater for a natural gas-fired plant located at an alternative site is a possibility. Groundwater withdrawals at an alternative site would likely require a permit from the State of South Carolina. For alternate greenfield sites, the impact to groundwater would depend on the site characteristics, including the amount of groundwater available. Overall, the impacts are considered SMALL.

- **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. Hence, it would be subject to the same air quality regulations as a coal-fired plant.

A new gas-fired generating plant located at V.C. Summer would likely need a prevention of significant deterioration permit and an operating permit under the Clean Air Act. A new combined-cycle natural gas power plant would also be subject to the new source performance standards for such units at 40 CFR Part 60, Subparts Da and GG. These regulations establish emission limits for particulates, opacity, SO_2, and NO_x. Obtaining air permits for construction of a combined-cycle plant would potentially require emission offsets from other generating facilities.

Section 169A of the Clean Air Act (42 USC 7491) establishes a national goal of preventing future and remedying existing impairment of visibility in mandatory Class I Federal areas when impairment results from human-made air pollution. 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 attainment or unclassified under the Clean Air Act. 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 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 natural gas-fired plant were located close to a mandatory Class I Federal area, additional air pollution control requirements could be imposed. South Carolina has only one area (Cape Romaine Wildlife Area) designated in 40 CFR 81.426 as a mandatory Class I Federal area in which visibility is an important value. This Class I Federal area is not within 80 km (50 mi) of V.C. Summer.

In 1998, the EPA issued a rule requiring 22 eastern states, including South Carolina, to revise their state implementation plans to reduce NO_x emissions. Nitrogen oxide emissions

contribute to violations of the national ambient air quality standard for ozone. The total amount of NO_x that can be emitted by each of the 22 states in the year 2007 ozone season (May 1 to September 30) is set out at 40 CFR 51.121(e). For South Carolina, the amount is 111,656 MT (123,105 tons).

SCE&G projects the following emissions for the natural gas-fired alternative (SCE&G 2002):

Sulfur oxides - 80 MT/yr (88 tons/yr)
Nitrogen oxides - 301 MT/yr (332 tons/yr)
Carbon monoxide - 395 MT/yr (435 tons/yr)
PM_{10} particulates - 118 MT/yr (130 tons/yr)

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

In December 2000, the EPA issued regulatory findings on emissions of hazardous air pollutants from electric utility steam-generating units (EPA 2000a). Natural gas-fired power plants were found by the EPA to emit arsenic, formaldehyde, and nickel (EPA 2000a). Unlike coal and oil-fired plants, the EPA did not determine that 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. These would be similar to the coal-fired alternative, but smaller due to the smaller construction work force.

The preceding emissions would likely be the same at V.C. Summer 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 V.C. Summer or at an alternate site is considered MODERATE.

- **Waste**

There will be small amounts of solid-waste products (i.e., ash) from burning natural gas. 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. Waste generation at a gas-fired plant would be largely limited to typical office wastes. Waste-generation impacts would be so minor that they would not noticeably alter any important resource attribute. Construction-related debris would be

generated during construction activities. Overall, the waste impacts would be SMALL for a natural gas-fired plant sited at V.C. Summer 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. Oil combustion generates waste in the form of ash, and equipment for controlling air pollution generates additional ash and scrubber sludge. The amount of ash and sludge generated would depend on the type and quantity of fuel oil combusted, Number 2 fuel oil doesn't produce any appreciable ash, while the heavier Number 6 fuel oil does. Overall, the waste impacts associated with fuel oil combustion at a combined-cycle plant are expected to be SMALL because the amount of oil combusted is expected to be relatively small. When natural gas is available, fuel oil is generally not price competitive with gas.

- **Human Health**

In the GEIS, the staff identified 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. NO_x emissions from a gas-fired plant in South Carolina would be regulated by SCDHEC. Human health effects are not expected to be detectable or would be 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 V.C. Summer or at an alternate site are considered SMALL.

- **Socioeconomics**

Construction and Operation. Construction of a natural gas-fired plant would take approximately three years. Peak employment would be approximately 1200 workers (NRC 1996). The staff assumed that construction would take place while V.C. Summer continues operation and would be completed by the time it permanently ceases operations. During construction, the communities surrounding the V.C. Summer site would experience demands on housing and public services that could have SMALL to MODERATE impacts. These impacts would be tempered by construction workers commuting to the site from cities such as Columbia. After construction, the communities would be impacted by the loss of jobs. The current V.C. Summer work force (740 permanent and contract workers) would decline through a decommissioning period to a minimal maintenance size. Approximately 150 workers would be needed to operate the natural gas-fired plant (a loss of about 590 jobs). The new natural gas-fired plant partially would replace the nuclear tax base in Fairfield and surrounding counties. The impacts could be SMALL to MODERATE and may be moderated by Fairfield County's proximity to Columbia.

Siting at an alternative site would result in the loss of the V.C. Summer tax base and associated employment in Fairfield and surrounding counties with potentially MODERATE to LARGE socioeconomic impacts. Socioeconomic impacts from locating the facilities at an alternative site would depend on the characteristics of the site. Impacts of construction could range between SMALL to MODERATE. Impacts during plant operation would be SMALL (smaller work force), and the tax impacts could be SMALL to LARGE, depending on the relative proportion of taxes paid by the plant to total county taxes. 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 work force would have the lowest socioeconomic impacts of any nonrenewable technology. Compared to the coal-fired and nuclear alternatives, socioeconomic impacts would be mitigated by the smaller construction work force, the shorter construction time frame, and the smaller operations work force.

Overall socioeconomic impacts resulting from construction of a natural gas-fired plant at V.C. Summer would be SMALL to MODERATE, and may be offset by the continued growth of the economy in the Columbia and surrounding area. For construction at an alternate site, socioeconomic impacts would be SMALL to LARGE, depending on the characteristics of the alternative site.

Transportation. Transportation impacts associated with construction and operating personnel commuting to the V.C. Summer site would be SMALL to MODERATE. The impacts can be classified as SMALL to LARGE for siting at an alternative site and would be dependent on the characteristics of the alternative site, including transportation infrastructure.

- **Aesthetics**

The turbine buildings and exhaust stacks would be visible during daylight hours from offsite creating incremental visual impacts to those from existing V.C. Summer facilities. The gas pipeline compressors would also be visible. Noise and light from the plant would be detectable offsite. At V.C. Summer, these impacts would result in a SMALL aesthetic impact.

At an alternate site, the buildings and stacks could be visible offsite. Aesthetic impacts could be mitigated if the plant were located in an industrial area adjacent to other power plants or industrial facilities. Overall, the aesthetic impacts associated with an alternate site are categorized as SMALL. The impacts would be greater if a new transmission line is needed and could be considered MODERATE. The impacts could be LARGE if a greenfield site is developed.

- **Historic and Archaeological**

  At both V.C. Summer 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 V.C. Summer 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). Historic and archaeological resource impacts need to be evaluated on a site-specific basis. The impacts can generally be effectively managed, and as such, impacts would vary between SMALL to MODERATE, depending on what historic and archaeologic resources are present, and whether mitigation is necessary.

- **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 V.C. Summer site. Some impacts on housing availability and prices during construction might occur, which could disproportionately affect minority and low-income populations. Closure of V.C. Summer would result in a decrease in employment of approximately 590 permanent and contract operating employees. Resulting economic conditions could reduce employment prospects for minority or low-income populations in Fairfield County. The impacts could be offset by projected economic growth and the ability of affected workers to commute to other jobs in Columbia or eastern Fairfield County. Overall, impacts are expected to be SMALL to MODERATE.

  Impacts at an alternate site would depend upon the site chosen and the nearby population distribution. Minority and low-income populations at the alternative site could benefit from the plant's relocation through improved job prospects and the increased tax base that could enable more services to be provided. These impacts could be SMALL to LARGE. However, if a replacement natural gas-fired plant were constructed at an alternative site, Fairfield County would experience a significant loss of property tax revenue, as well as jobs, which would affect the County's ability to provide services and

programs. Impacts to minority and low-income populations in Fairfield County could be MODERATE to LARGE, again potentially offset by other economic growth in the area not related to V.C. Summer.

8.2.2.2 Closed-Cycle Cooling System

This section discusses the environmental impacts of constructing a natural gas-fired generation system at an alternate location using closed-cycle cooling. The impacts (SMALL, MODERATE, or LARGE) of this option are the same as the impacts for a natural gas-fired plant using the once-through system. However, there are minor environmental impact 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 1300-MW U.S. Advanced Boiling Water Reactor (10 CFR Part 52 Appendix A), the 1300-MW System 80+ Design (10 CFR Part 52 Appendix B), and the 600-MW 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 escalation 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 V.C. Summer site using the existing once-through cooling system and at an alternate 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 V.C. Summer 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 V.C. Summer, which has a capacity of 966 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

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

Impact Category	Change in Impacts from Closed-Cycle Cooling System
Land Use	10 to 12 additional ha (25 to 30 ac) required for cooling towers and associated infrastructure.
Ecology	Impact would depend on ecology at the site. Additional impact to terrestrial biota 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. Decrease 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 plume. Possible noise impact from operation of cooling towers.
Historic and Archaeological Resources	No change.
Environmental Justice	No change.

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.

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 site will depend on the location of the particular site selected.

Table 8-6. Summary of Environmental Impacts of New Nuclear Power Generation at the V.C. Summer Site and an Alternate Greenfield Site Using Once-Through Cooling

	V.C. Summer 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 ha (500 ac) for the plant. Possible additional land if a new transmission line needed.
Ecology	SMALL to MODERATE	Uses undeveloped areas at current V.C. Summer site. 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.
Groundwater Use and Quality	SMALL	Groundwater not used, remaining the same as currently for V.C. Summer.	SMALL	Groundwater use similar to impacts at V.C. Summer; impacts depend on groundwater use and availability.
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 V.C. Summer 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 V.C. Summer 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 V.C. Summer site

Table 8-6. Summary of Environmental Impacts of New Nuclear Power Generation at the V.C. Summer Site and an Alternate Greenfield Site Using Once-Through Cooling (continued)

	V.C. Summer Site		Alternate Greenfield Site	
Impact Category	**Impact**	**Comments**	**Impact**	**Comments**
Socioeconomics	SMALL to LARGE	During construction, impacts would be SMALL to MODERATE. Up to 2500 workers during peak period of the five-year construction period. Operating work force assumed to be similar to V.C. Summer, base preserved. Impacts during operation would be SMALL. Transportation impacts associated with construction workers could be MODERATE to LARGE. Transportation impacts of commuting plant personnel would be SMALL.	SMALL to LARGE	Construction impacts depend on location. Impacts at a rural location could be LARGE. Fairfield County would experience loss of tax base and employment, potentially offset by economic growth of Columbia area. Operation impacts at an alternate site would be SMALL to MODERATE. Transportation impacts of construction workers could be MODERATE to LARGE. Transportation impacts of commuting plant personnel could 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	Impact would depend on the site selected and the surrounding land features. SMALL if previously developed site or adjacent to existing industrial area. LARGE if a greenfield site is selected. New transmission lines would add to the impact and would be MODERATE depending on the alternate site's characteristics.
Historic and Archeological Resources	SMALL to MODERATE	Some construction would affect previously developed parts of V.C. Summer; cultural resource inventory should minimize any impacts on undeveloped lands. Studies would likely be needed to identify, evaluate, and address mitigation of the potential impacts of new plant construction on undeveloped sites on cultural resources even at a developed site.	SMALL to MODERATE	Alternate location would necessitate cultural resource studies. Studies would likely be needed to identify, evaluate, and address mitigation of the potential impacts of new plant construction on undeveloped sites on cultural resources.

Table 8-6. Summary of Environmental Impacts of New Nuclear Power Generation at the V.C. Summer Site and an Alternate Greenfield Site Using Once-Through Cooling (continued)

	V.C. Summer Site		Alternate Greenfield Site	
Impact Category	**Impact**	**Comments**	**Impact**	**Comments**
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.	SMALL to LARGE	Impacts will vary depending on population distribution and makeup at the site. Impacts to minority and low-income residents of Fairfield County associated with closure of V.C. Summer - MODERATE to LARGE. Impacts to receiving county is site-specific and could range form SMALL to LARGE.

- **Land Use**

The existing facilities and infrastructure at the V.C. Summer 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 once-through cooling system, switchyard, offices, and transmission line right-of-way. Much of the land that would be used has been previously disturbed. A replacement nuclear power plant at the V.C. Summer site would alter approximately 200 ha (500 ac) of land, which likely would be previously disturbed. V.C. Summer would continue to operate as the new nuclear power facilities are being constructed.

There would be no net change in land needed for uranium mining because land needed for the new nuclear plant would offset land needed to supply uranium for fuel for the existing V.C. Summer reactor

The impact of a replacement nuclear generating plant on land use at the existing V.C. Summer site is best characterized as MODERATE. The impact would be greater than the OL renewal alternative.

Land-use requirements at an alternative site would be approximately 200 ha (500 ac) plus the possible need for a new transmission line (NRC 1996). In addition, it might be necessary to construct a rail spur to an alternative site to deliver equipment during construction. Depending on new transmission line routing, siting a new nuclear plant at an alternative site could result in MODERATE to LARGE land-use impacts, and probably would be LARGE for a previously undisturbed greenfield site.

- **Ecology**

  Locating a replacement nuclear power plant at the V.C. Summer site would alter ecological resources because of the need to convert roughly 200 ha (500 ac) of land to industrial use. Potential habitat loss and fragmentation and reduced productivity and biological diversity could result. Most of this land, however, has been previously disturbed. Siting at V.C. Summer would have a SMALL to MODERATE ecological impact that would be greater than renewal of the V.C. Summer OL.

  At an alternate site, there would be construction impacts and new incremental operational impacts. The impacts would be greatest at an alternate greenfield site. 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. Once-through cooling water withdrawal and discharge 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**

  Surface water. The staff assumed that a replacement nuclear power plant at V.C. Summer would 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.

  For alternate sites, the impact on the surface water would depend on the volume of water needed for makeup water, 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 of South Carolina. The impacts would be SMALL to MODERATE.

  Groundwater. No groundwater is currently used for operation of V.C. Summer. Two groundwater removal wells may be used to alleviate water seepage into the below-grade portions of the new nuclear plant buildings located at V.C. Summer. It is unlikely that groundwater would be used for an alternative nuclear power plant sited at V.C. Summer. The impacts are considered SMALL.

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

- **Air Quality**

Construction of a new nuclear plant sited at V.C. Summer or an alternate site would result in fugitive emissions during the construction. Exhaust emissions would also come from vehicles and motorized equipment used during the construction. An operating nuclear plant would have minor air emissions associated with diesel generators. Emissions would be regulated by the SCDHEC. 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. 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 V.C. Summer 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 V.C. Summer would not alter human health impacts. Therefore, the impacts would be SMALL.

- **Socioeconomics**

Construction and Operation. The construction period and the peak work force associated with new nuclear power plant construction are currently unquantified (NRC 1996). In the absence of quantified data, a construction period of five years and a peak work force of 2500 is assumed. The staff assumed that construction would take place while the existing nuclear unit continues operation and would be completed by the time V.C. Summer permanently ceases operations. During construction, the communities surrounding the

V.C. Summer site would experience demands on housing and public services that could have SMALL to MODERATE impacts. These impacts would be tempered by construction workers commuting to the site from outside Fairfield County. After construction, the communities would be impacted by the loss of the construction jobs.

The replacement nuclear unit is assumed to have an operating work force comparable to the 740 permanent and contract workers currently working at V.C. Summer. The replacement nuclear unit would provide a new tax base to offset the loss of tax base associated with decommissioning of V.C. Summer. For all of these reasons, the appropriate characterization of nontransportation socioeconomic impacts for replacement nuclear units constructed at V.C. Summer would be SMALL to MODERATE; the socioeconomic impacts would be noticeable, but would be unlikely to destabilize the area.

Socioeconomic impacts at alternate sites would need to be analyzed on a case-by-case basis. 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 work force would need to move to the area to work. Construction of a replacement nuclear power plant at an alternate site would relocate some socioeconomic impacts, but would not eliminate them. The communities around the V.C. Summer site would still experience the impact of operational job loss and loss of tax base, and the communities around the new site would have to absorb the impacts of a large, temporary work force (up to 2500 workers at the peak of construction) and a permanent work force of approximately 740 workers. For Fairfield County, the socioeconomic impacts could be LARGE. The impacts to the county at the alternate location could be SMALL to LARGE depending on the degree of economic development, the proportion of the county's property tax base represented by the new plant, etc.

Transportation. During the five-year construction period, up to 2500 construction workers would be working at the V.C. Summer site in addition to the 740 workers already employed there. The addition of the construction workers could place significant traffic loads on existing highways, particularly those leading to the V.C. Summer 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 V.C. Summer and are considered SMALL.

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 V.C. Summer and other associated buildings would likely be visible in daylight hours primarily from the Monticello Reservoir along SC 215. Visual impacts could be mitigated by landscaping and selecting a color for buildings that is consistent with the environment. The replacement nuclear units would also likely be visible at night because of outside lighting. Visual impact at night could be mitigated by reduced use of lighting and appropriate use of shielding. No exhaust stacks would be needed.

Noise from operation of a replacement nuclear plant potentially could be heard offsite under calm wind conditions or when the wind is blowing in the direction of the listener. Mitigation, such as reduced or no use of outside loudspeakers, can be employed to reduce noise levels and maintain the impact of noise to 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 is 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, or industrial facilities, in which case the impact is SMALL. The impact could be MODERATE if a transmission line needs to be built to the alternative site. The impacts could be LARGE if a greenfield site is selected.

- **Historic and Archaeological Resources**

At both V.C. Summer 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 V.C. Summer 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 need to be evaluated on a site-specific basis. The impacts can generally be effectively managed, and as such, impacts would vary

between SMALL to MODERATE, depending on what historic and archaeologic resources are present, and whether mitigation is necessary.

- **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 V.C. Summer site. Some impacts on housing availability and prices during construction might occur, and this could disproportionately affect the minority and low-income populations. However, this is expected to be mitigated by V.C. Summer's proximity to Columbia. After completion of construction, it is possible that the local government's ability to maintain social services could be reduced at the same time as diminished economic conditions reduce employment prospects for the minority and low-income populations. However, Fairfield County's economic health should be improved as the tax base of the older nuclear unit is replaced by the new, higher-valued (i.e., less depreciated) plant. Hence, the ability of the County to provide social services should improve because of the higher tax base, assuming assessment rates remain stable. Overall, 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, Fairfield County would experience a significant loss of property tax revenue, which could affect the county's ability to provide services and programs. Impacts to minority and low-income populations in Fairfield County could be MODERATE to LARGE but potentially offset by economic growth in Columbia. Impacts to the receiving county could be SMALL to LARGE and depend on the relative increase to the tax base resulting from the new plant's construction.

8.2.3.2 Closed-Cycle Cooling System

This section discusses the environmental impacts of constructing a nuclear power plant at an alternate location site using closed-cycle cooling. The impacts (SMALL, MODERATE, or LARGE) of this option are the same as the impacts for a nuclear power plant using the once-through system. However, there are environmental differences between the closed-cycle and once-through cooling systems. Table 8-7 summarizes the incremental differences.

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

Impact Category	Change in Impacts from Closed-Cycle Cooling System
Land Use	10 to 12 additional ha (25 to 30 ac) required 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. 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 plume. 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.

8.2.4 Purchased Electrical Power

If available, purchased power from other sources could potentially obviate the need to renew the V.C. Summer OL. SCE&G stated that power did not need to be purchased from out-of-state importers (SCE&G 2002).

Imported power from Canada or Mexico is unlikely to be available for replacement of V.C. Summer capacity. In Canada, 62 percent of the country's electrical generation capacity is derived from renewable energy sources, principally hydropower (DOE/EIA 2002). Canada has plans to continue developing hydroelectric power, but the plans generally do not include large-scale projects (DOE/EIA 2002). 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 United States imports of electricity from Canada and Mexico will gradually increase from 46.5 billion kWh in year 2000 to 68.7 billion kWh in year 2005 and then gradually decrease to 28.6 billion kWh in year 2020 (DOE/EIA 2002). Consequently, it is unlikely that electricity imported from Canada or Mexico would be able to replace V.C. Summer capacity.

If power to replace V.C. Summer capacity were to be purchased from sources within the United States 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 purchased electrical power alternative to renewal of the V.C. Summer OL. Thus, the environmental impacts of imported power would still occur but would be located elsewhere within the region, nation, or another country.

8.2.5 Other Alternatives

Other generation technologies considered by NRC are discussed in the following paragraphs.

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 period because of higher fuel costs and lower efficiencies (DOE/EIA 2001a). Oil-fired operation is more expensive than nuclear or coal-fired operation. 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. In Section 8.3.11 of the GEIS, the staff estimated that construction of a 1000-MW(e) oil-fired plant would require about 50 ha (120 ac). Additionally,

operation of oil-fired plants would have environmental impacts (such as impacts on the aquatic environment and air) that would be similar to those from a coal-fired plant.

8.2.5.2 Wind Power

Most of South Carolina 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]). Consequently, the staff concludes that locating a wind-energy facility on or near the V.C. Summer site would not be economically feasible given the current state of wind energy generation technology.

8.2.5.3 Solar Power

Solar technologies use the sun's energy and light to provide heating and cooling, light, hot water, and electricity for homes, businesses, and industry. Solar power technologies, photovoltaic and thermal, currently cannot 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, and the capacity factor for solar thermal systems is about 25 percent 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 and approximately 5700 ha (14,000 ac) per 1000 MW(e) for solar thermal systems. Neither type of solar electric system would fit at the V.C. Summer site, and both would have large environmental impacts at a greenfield site.

The V.C. Summer site receives approximately 4 to 5 kWh of 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 United States, 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 high cost, solar power is not deemed a feasible baseload alternative to renewal of the V.C. Summer OL. Some solar power may substitute for electric power in rooftop and building applications. Implementation of non-rooftop solar generation on a scale large enough to replace V.C. Summer would likely result in LARGE environmental impacts.

8.2.5.4 Hydropower

South Carolina has an estimated 480 MW of undeveloped hydroelectric resources (INEEL 1997). This amount is less than the amount needed to replace the 966-MW(e) capacity of V.C. Summer. As stated in Section 8.3.4 of the GEIS, hydropower's percentage of United States 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 (NRC 1996), the staff estimated that land requirements for hydroelectric power are approximately 400,000 ha (1 million ac) per 1000 MW(e). Replacement of V.C. Summer generating capacity would require flooding nearly this amount of land. Due to the relatively low amount of undeveloped hydropower resource in South Carolina and the large land use and related environmental and ecological resource impacts associated with siting hydroelectric facilities large enough to replace V.C. Summer, the staff concludes that local hydropower is not a feasible alternative to V.C. Summer OL renewal on its own. Any attempts to site hydroelectric facilities large enough to replace V.C. Summer 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 United States, Alaska, and Hawaii where hydrothermal reservoirs are prevalent. There is no feasible eastern location for geothermal capacity to serve as an alternative to renewal of the V.C. Summer OL. The staff concludes that geothermal energy is not a feasible alternative to renewal of the V.C. Summer OL.

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 percent to 80 percent and with 20 percent 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.

Fairfield County is roughly 177,414 ha (438,400 ac) and developed or urban land comprises just two percent of the County. The largest land use category is forest, accounting for 87 percent of the total acreage. This includes public, commercial, and noncommercial forests, as well as farm woodlands. Timber harvesting is a major agricultural sector in Fairfield County where the 1999 delivered value of timber was $32.2 million, placing the county third out of 46 in the state. The Clemson Agricultural Extension Service in Winnsboro estimates that tree harvesting has increased considerably during the past 20 years while the labor needed has decreased considerably.

However, due to uncertainties associated with obtaining sufficient wood and wood waste to fuel a baseload 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 V.C. Summer OL.

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 United States. This group of technologies processes 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 waste-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 alternative such as landfills; (2) the 1994 Supreme Court decision *(C&A Carbone, Inc. 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 might 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 2002).

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 2001b).

Currently there are approximately 102 waste-to-energy plants operating in the United States. 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 966 MW(e) of V.C. Summer and, consequently, would not be a feasible alternative to renewal of the V.C. Summer OL.

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 states 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 V.C. Summer. For these reasons, such fuels do not offer a feasible alternative to renewal of the V.C. Summer OL.

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.

The U.S. Department of Energy projects that 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 on the order of $500 to $600 per kW (NWPPC 2000). 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). Presently, fuel cells are not economically or technologically competitive with other alternatives for baseload electricity generation. Fuels cells are, consequently, not a feasible alternative to renewal of the V.C. Summer OL.

8.2.5.10 Delayed Retirement

SCE&G has no current plans to retire any existing generating units. For this reason, delayed retirement of other SCE&G generating units would not be a feasible alternative to renewal of the V.C. Summer OL.

8.2.5.11 Utility-Sponsored Conservation

SCE&G has developed residential, commercial, and industrial programs to reduce both the peak demands and daily energy consumption. These programs are commonly referred to as DSM. SCE&G currently operates the following DSM programs: standby generator program, interruptible service program, and real time pricing (SCE&G 2002). SCE&G stated that DSM programs and activities have been scaling back and that the trend is expected to continue (SCE&G 2002). However, SCE&G will continue their DSM.

Historic and projected reduction in generation needs as a result of DSM programs have been credited in SCE&G's planning to meet projected customer demand. Because these DSM savings are a part of the long-range plan for meeting projected demand, they are not available offsets for V.C. Summer. Therefore, the conservation option is not considered a reasonable replacement for the OL renewal alternatives.

8.2.6 Combination of Alternatives

Although individual alternatives to renewing the V.C. Summer OL might not be sufficient on their own to replace the capacity of this unit due to the small size or cost, it is conceivable that a combination of alternatives might be cost-effective.

As discussed in Section 8.2, V.C. Summer has a net electrical rating of 966 MW(e). For the coal and natural gas alternatives, SCE&G assumes in its ER two standard 408-MW(e) units as potential replacements for V.C. Summer (SCE&G 2002). This approach is followed in this SEIS, although it results in some environmental impacts that are roughly 16 percent lower than if full replacement capacity were constructed.

There are many possible combinations of alternatives to replace that power. Table 8-8 contains a summary of the environmental impacts of an assumed combination of alternatives consisting

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

	V.C. Summer Site		Alternate Greenfield Site	
Impact Category	**Impact**	**Comments**	**Impact**	**Comments**
Land Use	SMALL to MODERATE	Nine ha (23 ac) for powerblock, offices, roads, and parking areas. Additional impact of up to approximately 295 ha (729 ac) for construction of an underground gas pipeline.	SMALL to LARGE	23 ha (34 ac) for powerblock, offices, roads, and parking areas. Additional impact for construction and/or upgrade of an underground gas pipeline and transmission lines.
Ecology	SMALL to LARGE	Uses some undeveloped areas at current V.C. Summer site, plus land for a new gas pipeline.	SMALL 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. Greenfield site increases impact.
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.
Groundwater Use and Quality	SMALL	Groundwater not used, remaining the same as currently for V.C. Summer.	SMALL	Groundwater use similar to impacts at V.C. Summer; impacts depend on groundwater use and availability.
Air Quality	MODERATE	Natural Gas-Fired Units Some hazardous air pollutants Sulfur oxides • 40 MT/yr (44 tons/yr) Nitrogen oxides • 151 MT/yr (166 tons/yr) Carbon monoxide • 197 MT/yr (217 tons/yr) PM_{10} particulates • 59 MT/yr (65 tons/yr) Some hazardous air pollutants.	MODERATE	Same as siting at V.C. Summer.

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

	V.C. Summer Site		Alternate Greenfield Site	
Impact Category	**Impact**	**Comments**	**Impact**	**Comments**
Waste	SMALL	Small amount of ash produced.	SMALL	Same as siting at V.C. Summer.
Human Health	SMALL	Impacts considered to be minor.	SMALL	Impacts considered to be minor.
Socioeconomics	SMALL to MODERATE	During construction, impacts would be SMALL to MODERATE. Up to 1200 additional workers during the peak of the three-year construction period, followed by reduction from current V.C. Summer work force of 740 to 75; tax base preserved. Impacts during operation would be SMALL to MODERATE due to loss of employment to Fairfield County. Transportation impacts associated with construction workers would be SMALL to MODERATE. Transportation impacts during operation would be SMALL due to smaller work force.	SMALL to LARGE	Construction impacts depend on location, but could be significant if location is in a more rural area than V.C. Summer. Fairfield County would experience loss of tax base and employment, potentially offset by potential economic growth in Columbia area. Impacts during operation at an alternate site would be SMALL to MODERATE depending on economy at alternate site and relative impact of plant to tax base. Transportation impacts associated with construction workers would be SMALL to LARGE and dependent on population density at alternate site. Transportation impacts during operation would be SMALL due to smaller work force.
Aesthetics	SMALL	Some visibility of structure offsite.	SMALL to LARGE	SMALL if alternate site previously developed. MOD-ERATE impact from plant, stack, cooling tower plume, and new transmission lines. LARGE if greenfield site.

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

	V.C. Summer Site		Alternate Greenfield Site	
Impact Category	**Impact**	**Comments**	**Impact**	**Comments**
Historic and Archeological Resources	SMALL to MODERATE	Some construction would affect previously developed parts of V.C. Summer; cultural resource inventory should minimize any impacts on undeveloped lands. Studies would likely be needed to identify, evaluate, and address mitigation of the potential impacts of new plant construction on undeveloped sites on cultural resources even at a developed site.	SMALL to MODERATE	Alternate location would necessitate cultural resource studies. Studies would likely be needed to identify, evaluate, and address mitigation of the potential impacts of new plant construction on undeveloped sites on cultural resources.
Environmental Justice	SMALL to 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 595 operating jobs at V.C. Summer could reduce employment prospects for minority and low-income populations. Impacts could be offset by projected economic growth and the ability of affected workers to commute to other jobs.	SMALL to LARGE	Impacts at alternate site vary depending on population distribution and makeup at site. Fairfield County would lose significant revenue, which could have MODERATE to LARGE impacts to minority and low-income populations. Impacts to receiving county could be SMALL to MODERATE.

of one 408-MW(e) combined-cycle, natural gas-fired unit at V.C. Summer using the existing once-through cooling system, and at an alternate location using a once-through cooling system. Purchase from other power generators could account for 204 MW(e) of power, and 204 MW(e) could be gained from additional DSM measures. The impacts associated with the combined-cycle, natural gas-fired units are based on the 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 of imported power 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 V.C. Summer OL.

8.3 Summary of Alternatives Considered

The environmental impacts of the proposed action, license renewal, 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 alternative actions, i.e., 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) were considered.

The no-action alternative would require the replacement of electrical generating capacity by (1) DSM and energy conservation, (2) power purchased from other electricity providers, (3) generating alternatives other than V.C. Summer, or (4) some combination of these options and would result in the decommissioning of V.C. Summer. 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 and aesthetics impacts resulting from construction of any new facility would be greater than the impacts of continued operation of V.C. Summer. The impacts of purchased electrical power (imported 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 V.C. Summer OL.

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 20. Code of Federal Regulations, Title 10, *Energy*, Part 20, “Standards for Protection Against Radiation.”

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 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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