4.0 Environmental Impacts of Operation

Environmental issues associated with operation of a nuclear power plant during the renewal term are discussed in the *Generic Environmental Impact Statement for License Renewal of Nuclear Plants* (GEIS), NUREG-1437, Volumes 1 and 2 (NRC 1996, 1999b).[(a)] The GEIS includes a determination of whether the analysis of the environmental issues could be applied to all plants and whether additional mitigation measures would be warranted. Issues are then assigned a Category 1 or a Category 2 designation. As set forth in the GEIS, Category 1 issues are those that meet all of the following criteria:

(1) The environmental impacts associated with the issue have been determined to apply either to all plants or, for some issues, to plants having a specific type of cooling system or other specified plant or site characteristic.

(2) A single significance level (i.e., SMALL, MODERATE, or LARGE) has been assigned to the impacts (except for collective off-site radiological impacts from the fuel cycle and from high-level waste and spent fuel disposal).

(3) Mitigation of adverse impacts associated with the issue has been considered in the analysis, and it has been determined that additional plant-specific mitigation measures are likely not to be sufficiently beneficial to warrant implementation.

For issues that meet the three Category 1 criteria, no additional plant-specific analysis is required unless new and significant information is identified.

Category 2 issues are those that do not meet one or more of the criteria for Category 1 and, therefore, additional plant-specific review of these issues is required.

This chapter addresses the issues related to operation during the renewal term that are listed in Table B-1 of 10 CFR Part 51, Subpart A, Appendix B, and are applicable to the Dresden plant. Section 4.1 addresses issues applicable to the Dresden cooling system. Section 4.2 addresses issues related to transmission lines and on-site land use. Section 4.3 addresses the radiological impacts of normal operation, and Section 4.4 addresses issues related to the socioeconomic impacts of normal operation during the license renewal term. Section 4.5 addresses issues related to groundwater use and quality, and Section 4.6 discusses the

(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.

impacts of renewal term operations on threatened and endangered species. Section 4.7 addresses potential new and significant information that was identified during the scoping period. Section 4.8 addresses cumulative impacts of operations during the license renewal term. Section 4.9 summarizes enviornmental impacts of Dresden Units 2 and 3 operations. Finally, Section 4.10 lists the references for Chapter 4. Category 1 and Category 2 issues that are not applicable to Dresden because they are related to plant design features or site characteristics not found at Dresden are listed in Appendix F.

4.1 Cooling System

Category 1 issues in Table B-1 of 10 CFR Part 51, Subpart A, Appendix B, that are applicable to Dresden Units 2 and 3 cooling system operation during the renewal term are listed in Table 4-1. Exelon stated in its Environmental Report (ER) that it is not aware of any new and significant information associated with the renewal of the Dresden Units 2 and 3 (Exelon 2003a). The staff has not identified any new and significant information during the staff's independent review of the Exelon ER, the staff's site visit, public comments, or the staff's evaluation of other available information. Therefore, the staff concludes that there are no impacts related to these issues beyond those discussed in the GEIS. For all of the issues, the GEIS concluded that the impacts are SMALL, and that additional plant-specific mitigation measures beyond those already in place at Dresden Units 2 and 3 are not likely to be sufficiently beneficial to be warranted.

A brief description of the staff's review and the GEIS conclusions, as codified in Table B-1, for each of these issues follows:

- Altered current patterns at intake and discharge structures. Based on information in the GEIS, the Commission found that

  > Altered current patterns have not been found to be a problem at operating nuclear power plants and are not expected to be a problem during the license renewal term.

  The staff has not identified any new and significant information during the staff's independent review of the Dresden ER (Exelon 2003a), the scoping process, the staff's site visit, the staff's evaluation of other available information, and public comments on the draft SEIS. Therefore, the staff concludes that there are no impacts of altered current patterns at intake and discharge structures during the renewal term beyond those discussed in the GEIS.

Table 4-1. Category 1 Issues Applicable to the Operation of the Dresden Units 2 and 3 Cooling System During the Renewal Term

ISSUE—10 CFR Part 51, Subpart A, Appendix B, Table B-1	GEIS Section
SURFACE-WATER QUALITY, HYDROLOGY, AND USE (FOR ALL PLANTS)	
Altered current patterns at intake and discharge structures	4.2.1.2.1; 4.3.2.2; 4.4.2
Temperature effects on sediment transport capacity	4.2.1.2.3; 4.4.2.2
Scouring caused by discharged cooling water	4.2.1.2.3; 4.4.2.2
Eutrophication	4.2.1.2.3; 4.4.2.2
Discharge of chlorine or other biocides	4.2.1.2.4; 4.4.2.2
Discharge of sanitary wastes and minor chemical spills	4.2.1.2.4; 4.4.2.2
Discharge of other metals in wastewater	4.2.1.2.4; 4.3.2.2; 4.4.2.2
Water-use conflicts (plants with once-through cooling systems)	4.2.1.3
AQUATIC ECOLOGY (FOR ALL PLANTS)	
Accumulation of contaminants in sediments or biota	4.2.1.2.4; 4.3.3; 4.4.3; 4.4.2.2
Entrainment of phytoplankton and zooplankton	4.2.2.1.1; 4.3.3; 4.4.3
Cold shock	4.2.2.1.5; 4.3.3; 4.4.3
Thermal plume barrier to migrating fish	4.2.2.1.6; 4.4.3
Distribution of aquatic organisms	4.2.2.1.6; 4.4.3
Premature emergence of aquatic insects	4.2.2.1.7; 4.4.3
Gas supersaturation (gas bubble disease)	4.2.2.1.8; 4.4.3
Low dissolved oxygen in the discharge	4.2.2.1.9; 4.3.3; 4.4.3
Losses from predation, parasitism, and disease among organisms exposed to sublethal stresses	4.2.2.1.10; 4.4.3
Stimulation of nuisance organisms	4.2.2.1.11; 4.4.3
AQUATIC ECOLOGY (FOR PLANTS WITH COOLING-TOWER-BASED HEAT DISSIPATION SYSTEMS)	
Entrainment of fish and shellfish in early life stages	4.3.3
Impingement of fish and shellfish	4.3.3
Heat shock	4.3.3

Table 4-1. (contd)

ISSUE—10 CFR Part 51, Subpart A, Appendix B, Table B-1	GEIS Section
TERRESTRIAL RESOURCES	
Cooling tower impacts on crops and ornamental vegetation	4.3.4
Cooling tower impacts on native plants	4.3.5.1
Bird collisions with cooling towers	4.3.5.2
Cooling pond impacts on terrestrial resources	4.4.4
HUMAN HEALTH	
Microbiological organisms (occupational health)	4.3.6
Noise	4.3.7

- Temperature effects on sediment transport capacity. Based on information in the GEIS, the Commission found that

  > These effects have not been found to be a problem at operating nuclear power plants and are not expected to be a problem during the license renewal term.

| The staff has not identified any new and significant information during the staff's independent review of the Dresden ER (Exelon 2003a), the scoping process, the staff's site visit, the staff's evaluation of other available information, and public comments on the draft SEIS. Therefore, the staff concludes that there are no impacts of temperature effects on sediment transport capacity during the renewal term beyond those discussed in the GEIS.

- Scouring caused by discharged cooling water. Based on information in the GEIS, the Commission found that

  > Scouring has not been found to be a problem at most operating nuclear power plants and has caused only localized effects at a few plants. It is not expected to be a problem during the license renewal term.

| The staff has not identified any new and significant information during the staff's independent review of the Dresden ER (Exelon 2003a), the scoping process, the staff's site visit, the staff's evaluation of other available information, and public comments on

the draft SEIS. Therefore, the staff concludes that there are no impacts of scouring caused by discharged cooling water during the renewal term beyond those discussed in the GEIS.

- Eutrophication. Based on information in the GEIS, the Commission found that

  > Eutrophication has not been found to be a problem at operating nuclear power plants and is not expected to be a problem during the license renewal term.

  The staff has not identified any new and significant information during the staff's independent review of the Dresden ER (Exelon 2003a), the scoping process, the staff's site visit, the staff's evaluation of other available information, including plant monitoring data and technical reports, and public comments on the draft SEIS. Therefore, the staff concludes that there are no impacts of eutrophication during the renewal term beyond those discussed in the GEIS.

- Discharge of chlorine or other biocides. Based on information in the GEIS, the Commission found that

  > Effects are not a concern among regulatory and resource agencies, and are not expected to be a problem during the license renewal term.

  The staff has not identified any new and significant information during the staff's independent review of the Dresden ER (Exelon 2003a), the scoping process, the staff's site visit, the staff's evaluation of other available information, including the National Pollutant Discharge Elimination System (NPDES) permit (IL0002224) for the Dresden site (Illinois Environmental Protection Agency [IEPA] 2000), plant monitoring data, technical reports, and public comments on the draft SEIS. Therefore, the staff concludes that there are no impacts of discharge of chlorine or other biocides during the renewal term beyond those discussed in the GEIS.

- Discharge of sanitary wastes and minor chemical spills. Based on information in the GEIS, the Commission found that

  > Effects are readily controlled through NPDES permit (IEPA 2000) and periodic modifications, if needed, and are not expected to be a problem during the license renewal term.

  The staff has not identified any new and significant information during the staff's independent review of the Dresden ER (Exelon 2003a), the scoping process, the staff's

site visit, the staff's evaluation of other available information, including the NPDES permit for the Dresden site (IEPA 2000), plant monitoring data, technical reports, and public comments on the draft SEIS. Therefore, the staff concludes that there are no impacts of discharges of sanitary wastes and minor chemical spills during the renewal term beyond those discussed in the GEIS.

- Discharge of other metals in wastewater. Based on information in the GEIS, the Commission found that

  > These discharges have not been found to be a problem at operating nuclear power plants with cooling-tower-based heat dissipation systems and have been satisfactorily mitigated at other plants. They are not expected to be a problem during the license renewal term.

The staff has not identified any new and significant information during the staff's independent review of the Dresden ER (Exelon 2003a), the scoping process, the staff's site visit, the staff's evaluation of other available information, including the NPDES permit for the Dresden site (IEPA 2000), which expires October 31, 2005, plant monitoring data, technical reports, and public comments on the draft SEIS. Therefore, the staff concludes that there are no impacts of discharges of other metals in wastewater during the renewal term beyond those discussed in the GEIS.

- Water-use conflicts (plants with once-through cooling systems). Based on information in the GEIS, the Commission found that

  > These conflicts have not been found to be a problem at operating nuclear power plants with once-through heat dissipation systems.

The staff has not identified any new and significant information during the staff's independent review of the Dresden ER (Exelon 2003a), the scoping process, the staff's site visit, the staff's evaluation of other available information, and public comments on the draft SEIS. Therefore, the staff concludes that there are no impacts of water-use conflicts associated with the once-through cooling system during the renewal term beyond those discussed in the GEIS.

- Accumulation of contaminants in sediments or biota. Based on information in the GEIS, the Commission found that

  > Accumulation of contaminants has been a concern at a few nuclear power plants but has been satisfactorily mitigated by replacing copper alloy condenser tubes with those of another metal. It is not expected to be a problem during the license renewal term.

  The staff has not identified any new and significant information during the staff's independent review of the Dresden ER (Exelon 2003a), the scoping process, the staff's site visit, the staff's evaluation of other available information, and public comments on the draft SEIS. Therefore, the staff concludes that there are no impacts of accumulation of contaminants in sediments or biota during the renewal term beyond those discussed in the GEIS.

- Entrainment of phytoplankton and zooplankton. Based on information in the GEIS, the Commission found that

  > Entrainment of phytoplankton and zooplankton has not been found to be a problem at operating nuclear power plants and is not expected to be a problem during the license renewal term.

  The staff has not identified any new and significant information during the staff's independent review of the Dresden ER (Exelon 2003a), the scoping process, the staff's site visit, the staff's evaluation of other available information, and public comments on the draft SEIS. Therefore, the staff concludes that there are no impacts of entrainment of phytoplankton and zooplankton during the renewal term beyond those discussed in the GEIS.

- Cold shock. Based on information in the GEIS, the Commission found that

  > Cold shock has been satisfactorily mitigated at operating nuclear plants with once-through cooling systems, has not endangered fish populations or been found to be a problem at operating nuclear power plants with cooling towers or cooling ponds, and is not expected to be a problem during the license renewal term.

  The staff has not identified any new and significant information during the staff's independent review of the Dresden ER (Exelon 2003a), the scoping process, the staff's site visit, the staff's evaluation of other available information, and public comments on the draft SEIS. Therefore, the staff concludes that there are no impacts of cold shock during the renewal term beyond those discussed in the GEIS.

- Thermal plume barrier to migrating fish. Based on information in the GEIS, the Commission found that

  > Thermal plumes have not been found to be a problem at operating nuclear power plants and are not expected to be a problem during the license renewal term.

| The staff has not identified any new and significant information during the staff's independent review of the Dresden ER (Exelon 2003a), the scoping process, the staff's site visit, the staff's evaluation of other available information, and public comments on the draft SEIS. Therefore, the staff concludes that there are no impacts of thermal plume barriers to migrating fish during the renewal term beyond those discussed in the GEIS.

- Distribution of aquatic organisms. Based on information in the GEIS, the Commission found that

  > Thermal discharge may have localized effects but is not expected to effect the larger geographical distribution of aquatic organisms.

| The staff has not identified any new and significant information during the staff's independent review of the Dresden ER (Exelon 2003a), the scoping process, the staff's site visit, the staff's evaluation of other available information, and public comments on the draft SEIS. Therefore, the staff concludes that there are no impacts on the distribution of aquatic organisms during the renewal term beyond those discussed in the GEIS.

- Premature emergence of aquatic insects. Based on information in the GEIS, the Commission found that

  > Premature emergence has been found to be a localized effect at some operating nuclear power plants but has not been a problem and is not expected to be a problem during the license renewal term.

| The staff has not identified any new and significant information during the staff's independent review of the Dresden ER (Exelon 2003a), the scoping process, the staff's site visit, the staff's evaluation of other available information, and public comments on the draft SEIS. Therefore, the staff concludes that there are no impacts of premature

emergence of aquatic insects during the renewal term beyond those discussed in the GEIS.

- Gas supersaturation (gas-bubble disease). Based on information in the GEIS, the Commission found that

  > Gas supersaturation was a concern at a small number of operating nuclear power plants with once-through cooling systems but has been satisfactorily mitigated. It has not been found to be a problem at operating nuclear power plants with cooling towers or cooling ponds and is not expected to be a problem during the license renewal term.

  The staff has not identified any new and significant information during the staff's independent review of the Dresden ER (Exelon 2003a), the scoping process, the staff's site visit, the staff's evaluation of other available information, and public comments on the draft SEIS. Therefore, the staff concludes that there are no impacts of gas supersaturation during the renewal term beyond those discussed in the GEIS.

- Low dissolved oxygen in the discharge. Based on information in the GEIS, the Commission found that

  > Low dissolved oxygen has been a concern at one nuclear power plant with a once-through cooling system but has been effectively mitigated. It has not been found to be a problem at operating nuclear power plants with cooling towers or cooling ponds and is not expected to be a problem during the license renewal term.

  The staff has not identified any new and significant information during the staff's independent review of the Dresden ER (Exelon 2003a), the scoping process, the staff's site visit, the staff's evaluation of other available information, and public comments on the draft SEIS. Therefore, the staff concludes that there are no impacts of low dissolved oxygen during the renewal term beyond those discussed in the GEIS.

- Losses from predation, parasitism, and disease among organisms exposed to sublethal stresses. Based on information in the GEIS, the Commission found that

  > These types of losses have not been found to be a problem at operating nuclear power plants and are not expected to be a problem during the license renewal term.

| The staff has not identified any new and significant information during the staff's independent review of the Dresden ER (Exelon 2003a), the scoping process, the staff's site visit, the staff's evaluation of other available information, and public comments on the draft SEIS. Therefore, the staff concludes that there are no impacts of losses from predation, parasitism, and disease among organisms exposed to sublethal stresses during the renewal term beyond those discussed in the GEIS.

- Stimulation of nuisance organisms. Based on information in the GEIS, the Commission found that

> Stimulation of nuisance organisms has been satisfactorily mitigated at the single nuclear power plant with a once-through cooling system where previously it was a problem. It has not been found to be a problem at operating nuclear power plants with cooling towers or cooling ponds and is not expected to be a problem during the license renewal term.

| The staff has not identified any new and significant information during the staff's independent review of the Dresden ER (Exelon 2003a), the scoping process, the staff's site visit, the staff's evaluation of other available information, and public comments on the draft SEIS. Therefore, the staff concludes that there are no impacts of stimulation of nuisance organisms during the renewal term beyond those discussed in the GEIS.

- Entrainment of fish and shellfish in early life stages. Based on information in the GEIS, the Commission found that

> Entrainment of fish has not been found to be a problem at operating nuclear power plants with this type of cooling system and is not expected to be a problem during the license renewal term.

| The staff has not identified any new and significant information during the staff's independent review of the Dresden ER (Exelon 2003a), the scoping process, the staff's site visit, the staff's evaluation of other available information, and public comments on the draft SEIS. Therefore, the staff concludes that there are no impacts of entrainment of fish and shellfish in early life stages during the renewal term beyond those discussed in the GEIS.

- Impingement of fish and shellfish. Based on information in the GEIS, the Commission found that

  > The impingement has not been found to be a problem at operating nuclear plants with this type of cooling system and is not expected to be a problem during the license renewal term.

  The staff has not identified any new and significant information during the staff's independent review of the Dresden ER (Exelon 2003a), the scoping process, the staff's site visit, the staff's evaluation of other available information, and public comments on the draft SEIS. Therefore, the staff concludes that there are no impacts of impingement of fish and shellfish during the renewal term beyond those discussed in the GEIS.

- Heat shock. Based on information in the GEIS, the Commission found that

  > Heat shock has not been found to be a problem at operating nuclear power plants with this type of cooling system and is not expected to be a problem during the license renewal term.

  The staff has not identified any new and significant information during the staff's independent review of the Dresden ER (Exelon 2003a), the scoping process, the staff's site visit, the staff's evaluation of other available information, and public comments on the draft SEIS. Therefore, the staff concludes that there are no impacts of heat shock during the renewal term beyond those discussed in the GEIS.

- Cooling tower impacts on crops and ornamental vegetation. Based on information in the GEIS, the Commission found that

  > Impacts from salt drift, icing, fogging, or increased humidity associated with cooling tower operation have not been found to be a problem at operating nuclear power plants and are not expected to be a problem during the renewal term.

  The staff has not identified any new and significant information during the staff's independent review of the Dresden ER (Exelon 2003a), the scoping process, the staff's site visit, the staff's evaluation of other available information, and public comments on the draft SEIS. Therefore, the staff concludes that there are no cooling tower impacts on crops and ornamental vegetation during the renewal term beyond those discussed in the GEIS.

- Cooling tower impacts on native plants. Based on information in the GEIS, the Commission found that

  > Impacts from salt drift, icing, fogging, or increased humidity associated with cooling tower operation have not been found to be a problem at operating nuclear power plants and are not expected to be a problem during the license renewal term.

| The staff has not identified any new and significant information during the staff's independent review of the Dresden ER (Exelon 2003a), the scoping process, the staff's site visit, the staff's evaluation of other available information, and public comments on the draft SEIS. Therefore, the staff concludes that there are no cooling tower impacts on native plants during the renewal term beyond those discussed in the GEIS.

- Bird collisions with cooling towers. Based on information in the GEIS, the Commission found that

  > These collisions have not been found to be a problem at operating nuclear power plants and are not expected to be a problem during the license renewal term.

| The staff has not identified any new and significant information during the staff's independent review of the Dresden ER (Exelon 2003a), the scoping process, the staff's site visit, the staff's evaluation of other available information, and public comments on the draft SEIS. Therefore, the staff concludes that there are no impacts of bird collisions with cooling towers during the renewal term beyond those discussed in the GEIS.

- Cooling pond impacts on terrestrial resources. Based on information in the GEIS, the Commission found that

  > Impacts of cooling ponds on terrestrial ecological resources are considered to be of small significance at all sites.

| The staff has not identified any new and significant information during the staff's independent review of the Dresden ER (Exelon 2003a), the scoping process, the staff's site visit, the staff's evaluation of other available information, and public comments on the draft SEIS. Therefore, the staff concludes that there are no impacts of cooling pond operations on terrestrial resources during the renewal term beyond those discussed in the GEIS.

- Microbiological organisms (occupational health). Based on information in the GEIS, the Commission found that

  > Occupational health impacts are expected to be controlled by continued application of accepted industrial hygiene practices to minimize worker exposures.

  The staff has not identified any new and significant information during the staff's independent review of the Dresden ER (Exelon 2003a), the scoping process, the staff's site visit, the staff's evaluation of other available information, and public comments on the draft SEIS. Therefore, the staff concludes that there are no impacts of microbiological organisms on occupational health during the renewal term beyond those discussed in the GEIS.

- Noise. Based on information in the GEIS, the Commission found that

  > Noise has not been found to be a problem at operating plants and is not expected to be a problem at any plant during the license renewal term.

  The staff has not identified any new and significant information during the staff's independent review of the Dresden ER (Exelon 2003a), the scoping process, the staff's site visit, the staff's evaluation of other available information, and public comments on the draft SEIS. Therefore, the staff concludes that there are no impacts of noise during the renewal term beyond those discussed in the GEIS.

The Category 2 issues related to cooling system operation during the renewal term applicable to Dresden Units 2 and 3 are discussed in the section that follows and are listed in Table 4-2 and discussed in the following sections.

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

The NRC specifies in 10 CFR 51.53(3)(ii)(A) that "if the applicant's plant utilizes cooling towers or cooling ponds and withdraws makeup water from a river whose annual flow rate is less than 3.15×10^{12} ft^3/yr (9×10^{10} m^3/yr), an assessment of the impact of the proposed action on the flow of the river and related impacts on instream and riparian ecological communities must be provided." For water use conflicts, the NRC further states in 10 CFR Part 51, Subpart A, Appendix B, Table B-1, "The issue has been a concern at nuclear power plants with cooling ponds and at plants with cooling towers. Impacts on instream and riparian communities near these plants could be of moderate significance in some situations."

Table 4-2. Category 2 Issues Applicable to the Operation of the Dresden Units 2 and 3 Cooling System During the Renewal Term

ISSUE—10 CFR Part 51, Subpart A, Appendix B, Table B-1	GEIS Section	10 CFR 51.53(c)(3)(ii) Subparagraph	SEIS Section
SURFACE-WATER QUALITY, HYDROLOGY, AND USE (FOR ALL PLANTS)			
Water use conflicts (plants with cooling ponds or cooling towers using makeup water from a small river with low flow)	4.3.2.1; 4.4.2.1	A	4.1.1
AQUATIC ECOLOGY (FOR PLANTS WITH ONCE-THROUGH AND COOLING POND HEAT-DISSIPATION SYSTEMS)			
Entrainment of fish and shellfish in early life stages	4.2.2.1.2; 4.4.3	B	4.1.2
Impingement of fish and shellfish	4.2.2.1.3; 4.4.3	B	4.1.3
Heat shock	4.2.2.1.4; 4.4.3	B	4.1.4
HUMAN HEALTH			
Microbiological organisms (public health)(plants using lakes or canals, or cooling towers or cooling ponds that discharge into a small river)	4.3.6	G	4.1.5

This issue is applicable to Dresden because the plant uses cooling canals, a cooling pond, and cooling towers; and it ultimately discharges to the Illinois River, which has a mean annual flow of 9.6×10^9 m^3/yr (3.4×10^{11} ft^3/yr) (U.S. Geological Survey [USGS] 2000) at the confluence of the two rivers and is categorized as a small river. The annual mean flow of the Illinois River at the USGS gaging station at Marseilles, Illinois, was used to represent flow at the Des Plaines River and the Kankakee River confluence. This gaging station is the closest USGS station to Dresden on the Illinois River, located approximately 42.7 km (26.5 river mi) downstream of Dresden. The flow data used extend over the period from water years (October through September) 1920 to 1999. The flow data also indicate a historical lowest recorded daily mean flow of 41 m^3/s (1460 ft^3/s) occurred on October 16, 1943, and November 10, 1999 (USGS 2000).

During its indirect open-cycle operation, Dresden withdraws up to 3566 m^3/min (2099 ft^3/s) of water from the Kankakee River side of the Dresden Pool for condenser cooling. During the closed-cycle operation, Dresden withdraws approximately 265 m^3/min (156 ft^3/s) from the

Kankakee River side of the Dresden Pool to compensate for evaporative, seepage, and blowdown losses in the cooling pond. Approximately 76 m^3/min (45 ft^3/s) of the river water withdrawn is makeup water for that lost to evaporation and seepage from the cooling pond. This represents 3 percent of the historical lowest recorded daily mean flow. During the indirect open-cycle operation, Dresden withdraws approximately 148 m^3/min (87 ft^3/s) of water as makeup water for that lost to evaporation and seepage from the cooling pond (85 m^3/min) [50 ft^3/s]) and cooling towers (63 m^3/min [37 ft^3/s]). Therefore, approximately 4.2 percent of the water withdrawn is lost to evaporation and seepage. Makeup water represents approximately 6 percent of the historical, lowest recorded daily mean flow for the Illinois River near Marseilles, Illinois. Changes in the Dresden Pool level at the confluence of the Kankakee and the Illinois Rivers caused by Dresden operations (i.e., evaporative losses and seepage) are SMALL. In conclusion, any impacts from Dresden on instream and riparian communities in the area of the Dresden intakes over the license renewal term would be SMALL and would not warrant mitigation.

The staff reviewed the Clean Water Act (CWA) Section 316(a) Demonstration for Dresden Units 2 and 3 and the ER relative to potential groundwater-use conflicts due to consumptive loss of aquifer recharge. Based on this review, the staff has concluded that the potential impacts are SMALL, and that additional mitigation is not warranted.

4.1.2 Entrainment of Fish and Shellfish in Early Life Stages

For power plants with cooling pond heat-dissipation systems, the entrainment of fish and shellfish in early life stages into cooling water systems associated with nuclear power plants is considered a Category 2 issue, requiring a site-specific assessment before license renewal.

The staff independently reviewed the Dresden Units 2 and 3 ER, visited the site, and reviewed the applicant's NPDES permit (IEPA 2000).

Section 316(b) of the CWA requires that the location, design, construction, and capacity of cooling water intake structures reflect the best technology available for minimizing adverse environmental impacts (33 USC 1326). Entrainment through the condenser cooling system of fish and shellfish in the early life stages is a potential adverse environmental impact that can be minimized by the best available technology. Exelon (as Commonwealth Edison [ComEd]) conducted a comprehensive CWA Section 316(b) Demonstration for the U.S. Environmental Protection Agency (EPA) for Dresden Units 2 and 3.

The 1976 entrainment study used for the 316(b) Demonstration was conducted during the period of reproductive activity (April through August), and included weekly quantitative sampling for fish eggs and larvae in the Des Plaines and Kankakee Rivers and at the station intake (ComED 1977). Fish eggs were not identified to taxonomic level. An estimated 1.1×10^8 fish eggs were entrained during the sampling period, representing 47 percent of the

eggs estimated to be in the Kankakee River drift and 38 percent of the eggs estimated to be in the combined drift of the Kankakee and the Des Plaines Rivers. Over 91 percent of the egg entrainment occurred during June 1976. The impacts of high egg entrainment levels on the fish population were not considered to be significant because fish egg mortality rates are normally high, the eggs of most fish in the study area are nonbuoyant or adhesive and do not normally occur in the drift, and fecundity is generally high for species that produce buoyant or semi-buoyant eggs and occur in the study area.

An estimated 7.7×10^7 larvae were entrained during the five-month study period, representing 32 percent of the total number of larvae estimated in the Kankakee River drift and 19 percent of the combined drift of the Kankakee and Des Plaines Rivers. Entrainment of fish larvae was highest in June, representing 63 percent of total estimated entrainment during the sampling period. Entrainment impact was highest among suckers, representing 74 percent of the total number of larvae estimated in the Kankakee River drift and 57 percent of the combined drift of the Kankakee and the Des Plaines Rivers; herring, 55 percent of the Kankakee population and 46 percent of the combined Kankakee/Des Plaines population); and channel catfish, 41 percent of the Kankakee population and 38 percent of the combined Kankakee/Des Plaines population. Although the impact of larval entrainment on the fish population was not quantified, it was not considered to be significant because larval mortality rates are normally high, the number of larvae in the drift represents only a small percentage of their number in the river, and some larval fish survive entrainment. The 316(b) Demonstration concluded that no significant detrimental effects had occurred in the population of organisms in the Dresden pool between the pre- and post-operational periods of study as a result of the operation of Dresden Units 2 and 3 (ComEd 1987). Subsequent NPDES permits, which are renewed every five years, have required no further entrainment studies. In compliance with the provisions of the CWA and the Illinois Environmental Protection Act, Illinois issued the current NPDES permit (IEPA 2000), which expires on October 31, 2005.

The staff has reviewed the available information. Based on the results of the entrainment studies, fisheries studies, and the operating history of the Dresden Units 2 and 3 intake structure, the staff concludes that the potential impacts of entrainment of fish and shellfish in the early life stages in the cooling water intake system are SMALL. During the course of the SEIS preparation, the staff considered mitigation measures for the continued operation of Dresden Units 2 and 3. When continued operation for an additional 20 years is considered as a whole, all of the specific effects on the environment (whether or not “significant”) were considered. Because there are no demonstrated, significant effects to the Dresden Pool fish population related to entrainment, the staff concludes that the measures in place (cooling canal, cooling towers, and cooling pond) provide mitigation for all impacts related to entrainment, and no further mitigation measures are warranted.

4.1.3 Impingement of Fish and Shellfish

For power plants with cooling pond intake systems, impingement of fish and shellfish on debris screens of cooling water systems associated with nuclear power plants is considered a Category 2 issue, requiring a site-specific assessment before license renewal.

The staff independently reviewed the Dresden Units 2 and 3 ER, visited the site, and reviewed the applicant's NPDES permit (IEPA 2000).

Section 316(b) of the CWA requires that the location, design, construction, and capacity of cooling water intake structures reflect the best technology available for minimizing adverse environmental impacts (33 USC 1326). The designed operation criteria are maintained in part by the removal of sediments that are deposited in the canal. Maintenance of the designed depth for the intake canal helps ensure that approach velocities at the screens meet criteria. The impingement of fish and shellfish on debris screens of the cooling system is a potential adverse environmental impact that can be minimized by the best available technology. Exelon (as ComEd) conducted a comprehensive CWA Section 316(b) Demonstration for the EPA for Dresden Units 2 and 3.

Impingement studies were conducted for a period of a year in 1975–76 for the 316(b) Demonstration (ComEd 1977) and again from June 15 to September 30 in 1986 (ComEd 1987). Gizzard shad was the most commonly impinged species, both numerically and in terms of biomass. Other species that comprised greater than 1 percent of the samples by number or weight included freshwater drum, channel catfish, emerald shiner, common carp, trout-perch, golden redhorse, smallmouth buffalo, and bluegill. Impingement rates were highest in late summer and early winter in the 1975–76 full-year study, and in August and September in the 1986 study. Both studies showed that small, young-of-year fish were the most frequently impinged due to their small size and high abundance (ComEd 1977, 1987). Larger, reproductively mature fish constituted a small portion of impingement losses. The 316(b) Demonstration concuded that no significant detrimental effects had occurred in the population of organisms in the Dresden Pool between the pre- and post-operational periods of study as a result of the operation of Dresden Units 2 and 3 (ComEd 1977). In compliance with the provisions of the CWA and the Illinois Environmental Protection Act, Illinois issued Dresden its current NPDES permit.

The staff has reviewed the available information. Based on the results of impingement studies, fish population studies, and the operating history of the Dresden Units 2 and 3 intake structure, the staff concludes that the potential impacts of impingement of fish and shellfish on the debris screens of the cooling water intake system are SMALL. During the course of the SEIS preparation, the staff considered mitigation measures for the continued operation of Dresden Units 2 and 3. When continued operation for an additional 20 years is considered as

a whole, all of the specific effects on the environment (whether or not "significant") were considered. Because there are no demonstrated, significant effects to Dresden Pool fish communities related to impingement, the staff concludes that the measures in place (intake screens, cooling canal, cooling towers, and cooling pond) provide mitigation for all impacts related to impingement, and that no further mitigation measures are warranted.

4.1.4 Heat Shock

For power plants with once-through cooling systems, the effects of heat shock are listed as a Category 2 issue and require plant-specific evaluation before license renewal. The NRC made impacts on fish and shellfish resources that resulted from heat shock a Category 2 issue because of continuing concerns about thermal discharge effects and the possible need to modify thermal discharges in the future in response to changing environmental conditions (NRC 1996).

The staff independently reviewed the Dresden Units 2 and 3 ER, visited the site, and reviewed the applicant's NPDES permit (IEPA 2000).

The operation of Dresden Units 2 and 3 utilizes a cooling pond, cooling towers, and withdrawals from the Kankakee River. The plant discharges to the Illinois River. The cooling system can be operated in either an indirect open-cycle or closed-cycle mode. Cooling towers can be used for supplemental cooling in either mode. Exelon also has Section 316(a) alternative thermal effluent limits. Section 316(a) of the CWA establishes a process whereby a thermal effluent discharger can demonstrate that thermal discharge limitations are more stringent than necessary to protect a balanced indigenous population of fish and wildlife, and obtain alternative facility-specific thermal discharge limits (33 USC 1326). Exelon (as ComEd) complied with 35 Illinois Administrative Code 302.211(f) and Section 316(a) of the CWA in demonstrating that the thermal discharge from Dresden Units 2 and 3 has not caused and cannot be reasonably expected to cause significant ecological damage to receiving waters as approved by the Illinois Pollution Control Board (IPCB) in PCB Order 73-359 (January 17, 1974) and PCB Order 73-1345 (July 9, 1981). The variance approval has become part of each subsequent NPDES permit as a Special Condition. The current NPDES permit expires on October 31, 2005.

In the past, Dresden site discharges above NPDES permit thermal limits have occurred. Exelon received one provisional variance from NPDES permit thermal limits in 2001 and two provisional variances from thermal limits in 1999 from the IPCB. The 2001 provisional variance was provided to allow restoration efforts in the Dresden Units 2 and 3 cooling towers to proceed. One of the 1999 provisional variances allowed additional hours to discharge water at temperatures between 90° and 93°F. The other 1999 provisional variance allowed extension of indirect open-cycle operation for 21 days. Both provisional variances in 1999

were the result of an extended heat wave and drought. Exelon conducted biological studies to characterize the response of fish and other aquatic life to the thermal conditions resulting from the provisional variances. Results of these studies indicated that the fish community near the Dresden site was not adversely impacted by the thermal conditions that resulted from the provisional variances in 1999 (ComEd 2000) or 2001 (Exelon 2002b). No fish kills or beds of dead or dying aquatic macrophytes were observed. As expected, there was a change in fish distribution during the higher temperature periods; temperature-tolerant fish remained in the warmer areas, and less temperature-tolerant species temporarily moved to other areas. As the temperatures decreased, fish diversity and abundance returned to previous levels (ComEd 2000; Exelon 2002b).

The staff has reviewed the available information and, based on the conditions of the NPDES permit and the operating history of the Dresden Units 2 and 3 discharge, concludes that the potential impacts of discharging heated water from the cooling water intake system are so minor that they will not noticeably alter any component of the aquatic ecosystem and are, therefore, SMALL. During the course of the SEIS preparation, the staff considered mitigation measures for the continued operation of Dresden Units 2 and 3. When continued operation for an additional 20 years is considered as a whole, all of the specific effects on the environment (whether or not "significant") were considered. Because the heated water discharged into the Dresden Pool does not change the temperature enough to adversely impact a balanced, indigenous population of fish and wildlife, the staff concluded that the measures in place (e.g., cooling canals, cooling towers, and cooling pond) provide mitigation for all impacts related to heat shock, and that no further mitigation measures are warranted.

4.1.5 Microbiological Organisms (Public Health)

For power plants discharging cooling water to cooling ponds, lakes, canals, or small rivers, the effects of microbiological organisms on human health are listed as a Category 2 issue and require plant-specific evaluation before license renewal. This issue is applicable to Dresden Units 2 and 3 because the plant uses cooling canals, cooling towers, and a cooling pond, and discharges to a small river. The Illinois River is categorized as a small river (USGS 2000) and has an average annual flow of 9.6×10^9 m^3/yr (3.4×10^{11} ft^3/yr) at the gaging station at Marseilles, Illinois, about 43 km (26.5 mi) downstream of Dresden Units 2 and 3. In addition, there is public access to the Illinois River, including recreational fishing, swimming, water skiing, and boating.

The Category 2 designation is based on the potential for public health impacts associated with thermal enhancement of *Naegleria fowleri,* a pathogenic amoeba, and other enteric pathogens that could not be determined generically. The NRC noted that impact of nuclear plant cooling towers and thermal discharges are considered to be of small significance if they do not enhance the presence of microorganisms that are detrimental to water quality and public health (NRC 1999a). The assessment criteria relate to thermal discharge temperature, thermal characteristics, thermal conditions for the enhancement of *N. fowleri* and other pathogens, and impact to public health.

The mean maximum monthly discharge temperature at Dresden Units 2 and 3 from January 1998 through September 2001 was 26.8°C (80.3°F) with a range of monthly maximum temperatures from 12.8°C (55.1°F) in February 1999 to 38°C (100.5°F) in July 1999. During warmer months (May through October), river temperatures could support survival of thermophilic microorganisms; however, temperatures are generally below the range most conducive to their growth. Disinfection of the sewage treatment plant effluent from the Dresden site reduces the likelihood that a seed source or inoculant would be introduced to the cooling canals, cooling pond, or the Illinois River. Additional cooling towers have been added (Exelon 2002a), which will further reduce discharge temperatures.

Exelon corresponded with the Illinois Department of Public Health (IDPH), requesting information on any studies that the agency might have conducted concerning *N. fowleri* or other thermophilic microorganisms in the vicinity of the Dresden site and any concerns the agency might have relative to these organisms (Jury 2002a). IDPH responded that the agency had not conducted any sampling in the discharge area; but based on the reported average temperatures in the discharge canal, the IDPH did not anticipate that there would be any appreciable public health risk from thermophilic microorganisms attributable to the operations of Dresden Units 2 and 3 (Mudgett 2002).

The staff independently reviewed the Dresden Units 2 and 3 ER, visited the site, and reviewed the applicant's NPDES permit (IEPA 2000). Based on the staff's review, the staff does not expect that operation of Dresden Units 2 and 3 cooling systems will change significantly over the license renewal term; and there is no reason to believe that discharge temperatures will increase, or that disinfection would cease. Thus, the staff concludes that potential effects of microbiological organisms on human health, resulting from the operation of the plant's cooling water discharge to the aquatic environment or in the vicinity of the site, are SMALL. The staff also concludes that the mitigation in place at the Dresden site (i.e., the management of the discharge temperatures into the Illinois River and sewage treatment) will control any potential growth of thermophilic microbiological organisms, and no further mitigation measures are warranted.

4.2 Transmission Lines

Five 345-kV transmission lines connecting Dresden Units 2 and 3 to the transmission system were identified in the final environmental statement (FES) for operation of Dresden Units 2 and 3 (AEC 1973). The applicant describes seven lines that currently connect Dresden Units 2 and 3 to the transmission system (Exelon 2003a). The seven lines include all or portions of the original five lines and two new lines.

The corridors containing the transmission lines that connect Dresden Units 2 and 3 to the transmission system have a length of about 355 km (220 mi) and cover about 2440 ha

(6030 ac). The corridors pass through land that is primarily flat farmland with a minimal amount of forest. The areas are mostly rural with low population densities. The longer lines cross numerous State and U.S. highways, including Interstate-80 and Interstate-55. Commonwealth Edison plans to maintain these transmission lines indefinitely.

Exelon maintains its transmission corridors by trimming and mowing and through the use of approved herbicides. Unless otherwise needed, vegetation management follows a five-year cycle. The preferred method of vegetation management is the use of low-volume foliar herbicides. This allows the elimination of undesirable species while preserving grasses, herbs, forbs, shrubs, and other low-growing vegetation. Herbicide application is performed according to label specifications by certified applicators.

Category 1 issues in 10 CFR Part 51, Subpart A, Appendix B, Table B-1, that are applicable to transmission lines from Dresden Units 2 and 3 are listed in Table 4-3. Exelon stated in its ER that it is not aware of any new and significant information associated with the renewal of the Dresden Units 2 and 3 operating licenses (OLs). The staff has not identified any new and significant information during the staff's independent review of the Dresden ER (Exelon 2003a), the scoping process, the staff's site visit, the staff's evaluation of other available information, and public comments on the draft SEIS. For all of those issues, the staff concluded in the GEIS that the impacts are SMALL, and that additional plant-specific mitigation measures are not likely to be sufficiently beneficial to be warranted.

Table 4-3. Category 1 Issues Applicable to the Dresden Transmission Lines During the Renewal Term

ISSUE—10 CFR Part 51, Subpart A, Appendix B, Table B-1	GEIS Section
TERRESTRIAL RESOURCES	
Power line right-of-way (ROW) management (cutting and herbicide application)	4.5.6.1
Bird collisions with power lines	4.5.6.2
Impacts of electromagnetic fields on flora and fauna (plants, agricultural crops, honeybees, wildlife, livestock)	4.5.6.3
Floodplains and wetlands on power line ROW	4.5.7
AIR QUALITY	
Air quality effects of transmission lines	4.5.2
LAND USE	
On-site land use	4.5.3
Power line ROW	4.5.3

A brief description of the staff's review and GEIS conclusions, as codified in Table B-1, for each of these issues follows:

- Power line ROW management (cutting and herbicide application). Based on information in the GEIS, the Commission found that

  > The impacts of right-of-way maintenance on wildlife are expected to be of small significance at all sites.

  The staff has not identified any new and significant information during the staff's independent review of the Dresden ER (Exelon 2003a), the scoping process, the staff's site visit, consultation with the U.S. Fish and Wildlife Service (FWS), the staff's evaluation of other information, and public comments on the draft SEIS. Therefore, the staff concludes that there are no impacts of power line ROW maintenance during the renewal term beyond those discussed in the GEIS.

- Bird collisions with power lines. Based on information in the GEIS, the Commission found that

  > Impacts are expected to be of small significance at all sites.

  The staff has not identified any new and significant information during the staff's independent review of the Dresden ER (Exelon 2003a), the scoping process, the staff's site visit, consultation with the FWS, the staff's evaluation of other information, and public comments on the draft SEIS. Therefore, the staff concludes that there are no impacts of bird collisions with power lines during the renewal term beyond those discussed in the GEIS.

- Impacts of electromagnetic fields on flora and fauna (plants, agricultural crops, honeybees, wildlife, livestock). Based on information in the GEIS, the Commission found that

  > No significant impacts of electromagnetic fields on terrestrial flora and fauna have been identified. Such effects are not expected to be a problem during the license renewal term.

  The staff has not identified any new and significant information during the staff's independent review of the Dresden ER (Exelon 2003a), the scoping process, the staff's site visit, the staff's evaluation of other available information, and public comments on the draft SEIS. Therefore, the staff concludes that there are no impacts of

electromagnetic fields on flora and fauna during the renewal term beyond those discussed in the GEIS.

- Floodplains and wetlands on power line ROWs. Based on information in the GEIS, the Commission found that

  > Periodic vegetation control is necessary in forested wetlands underneath power lines and can be achieved with minimal damage to the wetlands. No significant impact is expected at any nuclear power plant during the license renewal term.

  The staff has not identified any new and significant information during the staff's independent review of the Dresden ER (Exelon 2003a), the scoping process, the staff's site visit, consultation with the FWS, the staff's evaluation of other information, and public comments on the draft SEIS. Therefore, the staff concludes that there are no impacts of power line ROWs on floodplains and wetlands during the renewal term beyond those discussed in the GEIS.

- Air quality effects of transmission lines. Based on the information in the GEIS, the Commission found that

  > Production of ozone and oxides of nitrogen is insignificant and does not contribute measurably to ambient levels of these gases.

  The staff has not identified any new and significant information during the staff's independent review of the Dresden ER (Exelon 2003a), the scoping process, the staff's site visit, the staff's evaluation of other available information, and public comments on the draft SEIS. Therefore, the staff concludes that there are no air quality impacts of transmission lines during the renewal term beyond those discussed in the GEIS.

- On-site land use. Based on the information in the GEIS, the Commission found that

  > Projected on-site land use changes required during . . . the renewal period would be a small fraction of any nuclear power plant site and would involve land that is controlled by the applicant.

  The staff has not identified any new and significant information during the staff's independent review of the Dresden ER (Exelon 2003a), the scoping process, the staff's site visit, the staff's evaluation of other available information, and public comments on the draft SEIS. Therefore, the staff concludes that there are no on-site land-use impacts during the renewal term beyond those discussed in the GEIS.

- Power line ROW (land use). Based on information in the GEIS, the Commission found that

  > Ongoing use of power line right of ways would continue with no change in restrictions. The effects of these restrictions are of small significance.

| The staff has not identified any new and significant information during the staff's independent review of the Dresden ER (Exelon 2003a), the scoping process, the staff's site visit, the staff's evaluation of other available information, and public comments on the draft SEIS. Therefore, the staff concludes that there are no impacts of power line ROWs during the renewal term beyond those discussed in the GEIS.

There is one Category 2 issue related to transmission lines, and another issue related to transmission lines is being treated as a Category 2 issue. These issues are listed in Table 4-4 and are discussed in Sections 4.2.1 and 4.2.2.

Table 4-4. Category 2 and Uncategorized Issues Applicable to the Dresden Transmission Lines During the Renewal Term

ISSUE—10 CFR Part 51, Subpart A, Appendix B, Table B-1	GEIS Section	10 CFR 51.53(c)(3)(ii) Subparagraph	SEIS Section
	HUMAN HEALTH		
Electromagnetic fields, acute effects (electric shock)	4.5.4.1	H	4.2.1
Electromagnetic fields, chronic effects	4.5.4.2	NA	4.2.2

4.2.1 Electromagnetic Fields—Acute Effects

In the GEIS, the Commission found that without a review of the conformance of each nuclear plant transmission line with National Electrical Safety Code (NESC) (Institute of Electrical and Electric Engineeers [IEEE] 1997) criteria, it is not possible to determine the significance of the electric shock potential. Evaluation of individual plant transmission lines is necessary because the issue of electric shock safety was not addressed in the licensing process for some plants. For other plants, land use in the vicinity of transmission lines may have changed; or power distribution companies may have chosen to upgrade line voltage. To comply with 10 CFR 51.53(c)(3)(ii)(H), the applicant must provide an assessment of the potential shock hazard if the transmission lines that were constructed for the specific purpose of connecting the plant to the transmission system do not meet the recommendations of the NESC for preventing electric shock from induced currents.

Five 345-kV transmission lines connecting Dresden Units 2 and 3 to the transmission system were identified in the FES for operation of Dresden Units 2 and 3 (AEC 1973). These lines included a pair of 1.8-km (1.1-mi) lines to existing transmission lines between the Pontiac substation (south) and the Electric Junction substation (north), a new line from Dresden to the Electric Junction substation (50 km [31.1 mi]), and a pair of new lines from Dresden to the Goodings Grove substation (48 km [29.8 mi]). Potential electric shock impacts of these lines were not addressed in the FES.

The applicant describes seven lines that currently connect Dresden Units 2 and 3 to the transmission system (Exelon 2003a). The seven lines include all or portions of the original five lines and two new lines. Each of the seven lines has been reviewed to identify the configuration where the potential for current-induced shock would be the greatest. The electric field strength and induced current were calculated for each limiting configuration using the AC/DC LINE computer code produced by the Electric Power Research Institute (EPRI 1991).

The only line for which the calculated induced current exceeded the NESC 5-mA induced current standard was the line to the Pontiac substation. The location where the calculated induced current exceeded the standard is in a portion of line to the Pontiac substation that was not constructed to connect Dresden Units 2 and 3 to the transmission system. The calculated induced current was 5.2 mA, which, although greater than the NESC standard, is lower than the limiting current for ground-fault interrupts installed in homes.

The staff has reviewed the applicant's evaluation and computational results. Based on this review, the staff concludes that the impact of the potential for electric shock is SMALL, and that no further mitigation measures are warranted.

4.2.2 Electromagnetic Fields—Chronic Effects

In the GEIS, the chronic effects of 60-Hz electromagnetic fields from power lines were not designated as Category 1 or 2 and will not be until a scientific consensus is reached on the health implications of these fields.

The potential for chronic effects from these fields continues to be studied and is not known at this time. The National Institute of Environmental Health Sciences (NIEHS) directs related research through the U.S. Department of Energy. A 1999 NIEHS report contains the following conclusion:

> The NIEHS concludes that ELF-EMF [extremely low frequency-electromagnetic field] exposure cannot be recognized as entirely safe because of weak scientific evidence that exposure may pose a leukemia hazard. In our opinion, this finding is insufficient to warrant

aggressive regulatory concern. However, because virtually everyone in the United States uses electricity and therefore is routinely exposed to ELF-EMF, passive regulatory action is warranted such as a continued emphasis on educating both the public and the regulated community on means aimed at reducing exposures. The NIEHS does not believe that other cancers or non-cancer health outcomes provide sufficient evidence of a risk to currently warrant concern (NIEHS 1999).

| This statement is not sufficient to cause the staff to change the staff's position with respect to the chronic effects of electromagnetic fields. The staff considers the GEIS finding of "not applicable" still appropriate and will continue to follow developments on this issue.

4.3 Radiological Impacts of Normal Operations

Category 1 issues in 10 CFR Part 51, Subpart A, Appendix B, Table B-1, that are applicable to Dresden Units 2 and 3 in regard to radiological impacts are listed in Table 4-5. Exelon stated in its ER (Exelon 2003a) that it is not aware of any new and significant information associated with the renewal of the Dresden Units 2 and 3 OLs.

| The staff has not identified any new and significant information during the staff's independent
| review of the Dresden ER (Exelon 2003a), the scoping process, the staff's site visit, the staff's
| evaluation of other available information, and public comments on the draft SEIS. Therefore, the staff concludes that there are no impacts related to these issues beyond those discussed in the GEIS. For all of those issues, the staff concluded in the GEIS that the impacts are SMALL, and that additional plant-specific mitigation measures are not likely to be sufficiently beneficial to be warranted.

Table 4-5. Category 1 Issues Applicable to Radiological Impacts of Normal Operations During the Renewal Term

ISSUE—10 CFR Part 51, Subpart A, Appendix B, Table B-1	GEIS Section
HUMAN HEALTH	
Radiation exposures to public (license renewal term)	4.6.2
Occupational radiation exposures (license renewal term)	4.6.3

A brief description of the staff's review and the GEIS conclusions, as codified in Table B-1, for each of these issues follows.

- Radiation exposures to public (license renewal term). Based on information in the GEIS, the Commission found that

  > Radiation doses to the public will continue at current levels associated with normal operations.

  The staff has not identified any new and significant information during the staff's independent review of the Dresden ER (Exelon 2003a), the scoping process, the staff's site visit, the staff's evaluation of other available information, and public comments on the draft SEIS. Therefore, the staff concludes that there are no impacts of radiation exposures to the public during the renewal term beyond those discussed in the GEIS.

- Occupational radiation exposures (license renewal term). Based on information in the GEIS, the Commission found that

  > Projected maximum occupational doses during the license renewal term are within the range of doses experienced during normal operations and normal maintenance outages and would be well below regulatory limits.

  The staff has not identified any new and significant information during the staff's independent review of the Dresden ER (Exelon 2003a), the scoping process, the staff's site visit, the staff's evaluation of other available information, and public comments on the draft SEIS. Therefore, the staff concludes that there are no impacts of occupational radiation exposures during the renewal term beyond those discussed in the GEIS.

There are no Category 2 issues related to radiological impacts of routine operations.

In another venue [an NRC scoping meeting on July 10, 2003, to update the GEIS (NUREG-1437) that was held in Oaklawn, IL], a member of the public raised concerns regarding effluent releases from the Dresden Nuclear Power Plant. The concern related to information indicating that Dresden had the highest airborne radioactive emissions of the 72 US nuclear sites. Nuclear power plants are designed to release radiological effluents to the environment. The amount of radioactive material released to the environment does vary from facility to facility and is dependent on the type of facility, the size of the facility, the length of time the facility has operated and other factors. Liquid and gaseous effluent releases must meet requirements in 10 CFR Part 20, Appendix B, Table 2. These limits are designed to be protective of the health and safety of the public and the environment. As part of the environmental review for the Dresden license renewal application, the NRC staff reviewed reports from the Dresden environmental program for the last several years. Based on the data, releases to the environment were well below regulatory limits (see Section 2.2.7). The NRC

routinely performs inspections of the licensee's environmental monitoring program. The procedures and results of the monitoring programs are inspected and reviewed by the NRC staff to ensure requirements are being met. Therefore, even if Dresden has higher releases relative to other nuclear power plants, the amount of radioactive material released to the environment is still well within regulatory requirements and protective of the health and safety of the public.

4.4 Socioeconomic Impacts of Plant Operations During the License Renewal Period

Category 1 issues in 10 CFR Part 51, Subpart A, Appendix B, Table B-1, that are applicable to socioeconomic impacts during the renewal term are listed in Table 4-6. Exelon stated in its ER that it is not aware of any new and significant information associated with the renewal of Dresden Units 2 and 3 OLs (Exelon 2003a). Further, Exelon has determined that there is no need to undertake major refurbishment or replacement actions to maintain important systems, structures, and components during the license renewal period.

The staff has not identified any new and significant information during the staff's independent review of the Dresden ER (Exelon 2003a), the scoping process, the staff's site visit, the staff's evaluation of other available information, and public comments on the draft SEIS. Therefore, the staff concludes that there are no impacts related to these issues beyond those discussed in the GEIS (NRC 1996). For these issues, the staff concluded in the GEIS that the impacts are SMALL, and that additional plant-specific mitigation measures are not likely to be sufficiently beneficial to be warranted.

Table 4-6. Category 1 Issues Applicable to Socioeconomics During the Renewal Term

ISSUE—10 CFR Part 51, Subpart A, Appendix B, Table B-1	GEIS Section
SOCIOECONOMICS	
Public services: public safety, social services, and tourism and recreation	4.7.3; 4.7.3.3; 4.7.3.4; 4.7.3.6
Public services: education (license renewal term)	4.7.3.1
Aesthetic impacts (license renewal term)	4.7.6
Aesthetic impacts of transmission lines (license renewal term)	4.5.8

A brief description of the staff's review and the GEIS conclusions, as codified in Table B-1, for each of these issues follows.

- Public services: public safety, social services, and tourism and recreation. Based on information in the GEIS, the Commission found that

  > Impacts to public safety, social services, and tourism and recreation are expected to be of small significance at all sites.

  The staff has not identified any new and significant information during the staff's independent review of the Dresden ER (Exelon 2003a), the scoping process, the staff's site visit, the staff's evaluation of other available information, and public comments on the draft SEIS. Therefore, the staff concludes that there are no impacts on public safety, social services, and tourism and recreation during the renewal term beyond those discussed in the GEIS.

- Public services: education (license renewal term). Based on information in the GEIS, the Commission found that

  > Only impacts of small significance are expected.

  The staff has not identified any new and significant information during the staff's independent review of the Dresden ER (Exelon 2003a), the scoping process, the staff's site visit, the staff's evaluation of other available information, and public comments on the draft SEIS. Therefore, the staff concludes that there are no impacts on education during the renewal term beyond those discussed in the GEIS.

- Aesthetic impacts (license renewal term). Based on information in the GEIS, the Commission found that

  > No significant impacts are expected during the license renewal term.

  The staff has not identified any new and significant information during the staff's independent review of the Dresden ER (Exelon 2003a), the scoping process, the staff's site visit, the staff's evaluation of other available information, and public comments on the draft SEIS. Therefore, the staff concludes that there are no aesthetic impacts during the renewal term beyond those discussed in the GEIS.

- Aesthetic impacts of transmission lines (license renewal term). Based on information in the GEIS, the Commission found that

  > No significant impacts are expected during the license renewal term.

  The staff has not identified any new and significant information during the staff's independent review of the Dresden ER (Exelon 2003a), the scoping process, the staff's site visit, the staff's evaluation of other available information, and public comments on

| the draft SEIS. Therefore, the staff concludes that there are no aesthetic impacts of transmission lines during the renewal term beyond those discussed in the GEIS.

Table 4-7 lists the Category 2 socioeconomic issues, which require plant-specific analysis and environmental justice, which was not addressed in the GEIS.

Table 4-7. Environmental Justice and GEIS Category 2 Issues Applicable to Socioeconomics During the Renewal Term

ISSUE—10 CFR Part 51, Subpart A, Appendix B, Table B-1	GEIS Section	10 CFR 51.53(c)(3)(ii) Subparagraph	SEIS Section
	SOCIOECONOMICS		
Housing impacts	4.7.1	I	4.4.1
Public services: public utilities	4.7.3.5	I	4.4.2
off-site land use (license renewal term)	4.7.4	I	4.4.3
Public services, transportation	4.7.3.2	J	4.4.4
Historic and archaeological resources	4.7.7	K	4.4.5
Environmental Justice	Not addressed[(a)]	Not addressed[(a)]	4.4.6

(a) Guidance related to environmental justice was not in place at the time the GEIS and the associated revision to 10 CFR Part 51 were prepared. Therefore, environmental justice must be addressed in the licensee's ER and the staff's environmental impact statement.

4.4.1 Housing Impacts During Operations

| To determine housing impacts, the applicant followed Appendix C of the GEIS (NRC 1996), | which presents a population characterization method that is based on two factors, "sparseness" | and "proximity" (GEIS, Section C.1.4 [NRC 1996, 1999b]). Sparseness measures population | density within 32 km (20 mi) of the site, and proximity measures population density and city size | within 80 km (50 mi). Each factor has categories of density and size (GEIS Table C.1), and a | matrix is used to rank the population category as low, medium, or high (GEIS Figure C.1).

According to the U.S. Bureau of the Census (USBC) 2000 information, the population living within 32 km (20 mi) of the Dresden site was estimated to be approximately 338,000 (Exelon 2003). This translates to about 103 persons/km^2 (270 persons/mi^2) living on the land area present within a 32-km (20-mi) radius of the Dresden site. This concentration falls into the GEIS sparseness Category 4 (i.e., having greater than or equal to 46 persons/km^2 [120 persons/mi^2]). As estimated from the USBC 2000 information, at least 7 million people live

within 80 km (50 mi). This equates to a population density of 350 persons/km^2 (900 persons/mi^2) within 80 km (50 mi). Applying the GEIS proximity measures (NRC 1996), Dresden is classified as Category 4 (i.e., having greater than or equal to 73 persons/km^2 [190 persons/mi^2]) within 80 km (50 mi) of the site. According to the GEIS, these sparseness and proximity scores identify that Dresden is located in a high-population area.

In 10 CFR Part 51, Subpart A, Appendix B, Table B-1, the NRC concluded that impacts on housing availability are expected to be of small significance at plants located in a high-population area where growth control measures are not in effect. The Dresden site is located in a high-population area and, although both Grundy and Will counties and their municipal governments attempt to direct growth within the established growth boundaries without sprawl, growth control measures are not in effect. Based on the NRC criteria, Exelon expects housing impacts to be SMALL during continued operation (Exelon 2003a).

SMALL impacts result when no discernible change in housing availability occurs, changes in rental rates and housing values are similar to those occurring statewide, and no housing construction or conversion is required to meet new demand (NRC 1996). The GEIS assumes that no more than a total additional staff of 60 permanent workers might be needed at each unit during the license renewal period to perform routine maintenance and other activities related to license renewal. Exelon expects to add no more than 60 total employees to the permanent staff during license renewal to perform these routine activities. This addition of 60 permanent workers, plus 111 indirect jobs (Exelon 2003a), would result in an increased demand for a total of 171 housing units around the Dresden site (or 123 housing units for Grundy and Will counties).[(a)] The demand for the existing housing units could be met with the construction of new housing or the use of existing, unoccupied housing. In an area that has a population of more than 500,000, this demand would not create a discernible change in housing availability, change in rental rates or housing values, or spur much new construction or conversion. As a result, Exelon concludes that the impacts would be SMALL, and that mitigation measures would not be necessary (Exelon 2003a).[(b)]

The staff reviewed the available information relative to housing impacts and Exelon's conclusions. Based on this review, the staff concludes that the impact on housing during the license renewal period would be SMALL, and that no further mitigation measures are warranted.

(a) This assumes that 72 percent of the new hires would reside in the two counties (see Section 2.2.8.1).
(b) Exelon's estimate of 123 housing units is likely to be an extreme "upper bound" estimate. Most of the potentially new jobs would most likely be filled by existing area residents, thus creating no, or little, net demand for housing.

4.4.2 Public Services: Public Utility Impacts During Operations

Impacts on public utility services are considered SMALL if there is little or no change in the ability of the system to respond to the level of demand and, thus, there is no need to add capital facilities. Impacts are considered MODERATE if overtaxing of service capabilities occurs during periods of peak demand. Impacts are considered LARGE if existing levels of service (e.g., water or sewer services) are substantially degraded and additional capacity is needed to meet ongoing demands for services. The GEIS indicates that, in the absence of new and significant information to the contrary, the only impacts on public utilities that could be significant are impacts on public water supplies (NRC 1996).

Analysis of impacts on the public water supply system considered both plant demand and plant-related population growth. Section 2.2.2 describes the Dresden Units 2 and 3 permitted withdrawal rate and actual use of water. Because Exelon plans no refurbishment in conjunction with this license renewal, plant demand would not change beyond current demands (Exelon 2003a).

Exelon assumed an increase of 60 permanent employees during license renewal, the generation of 171 new jobs, and a net overall population increase of approximately 326 persons and 123 households as a result of those jobs,[(a)] all of which would create SMALL impacts. The plant-related population increase would require an additional 118 m^3/d (26,080 gpd) of potable water (Exelon 2003a).[(b)] This amount is within the residual capacity of the existing water systems that service Grundy and Will counties. The current approximate average daily demand for both counties combined is 186,000 m^3/d (41 million gpd), with a maximum daily capacity of 529,000 m^3/d (116 million gpd). The additional 118 m^3/d is less than 0.01 percent of the current demand. The staff finds that the impact of increased water use on area water systems is SMALL, and that no further mitigation measures are warranted.

4.4.3 Off-Site Land Use During Operations

Off-site land use during the license renewal term is a Category 2 issue (10 CFR Part 51, Subpart A, Appendix B, Table B-1). Table B-1 of 10 CFR Part 51, Subpart A, Appendix B, notes that "significant changes in land use may be associated with population and tax revenue changes resulting from license renewal."

(a) Calculated by assuming that the average number of households is 1 per new job and household size is 2.65 persons per household (Exelon 2003a).

(b) Calculated assuming that the average American uses between 50 to 80 gallons of water for personal use per day; 326 people x 80 gal per person per day = 26,080 gpd (118 m^3/d).

Section 3.7.5 and 4.7.4 of the GEIS defines the magnitude of land-use changes as a result of plant operation during the licence renewal term as follows:

SMALL — Little new development and minimal changes to an area's land-use pattern.

MODERATE — Considerable new development and some changes to the land-use pattern.

LARGE — Large-scale new development and major changes in the land-use pattern.

Exelon has identified a maximum of 60 additional employees during the license renewal term plus an additional 111 indirect jobs (for a total of 171) in the region (Exelon 2003a). As stated in Section 3.7.5 of the GEIS (NRC 1996), the staff found that, if plant-related population growth is less than 5 percent of the study area's total population, off-site land-use changes would be SMALL, especially if the study area has established patterns of residential and commercial development, a population density of at least 23 persons/km^2 (60 persons/mi^2), and at least one urban area with a population of 100,000 or more within 80 km (50 mi). In this case, population growth will be less than 5 percent of the total population of Grundy and Will counties. Each county in the area has established patterns of residential and commercial development guided by comprehensive plans, a population density of 901 persons /mi^2 within an 80-km (50-mi) radius, and one urban area (Chicago) with a metropolitan area population of 8.9 million (Exelon 2003a). Consequently, the staff concludes that population changes resulting from license renewal are likely to result in SMALL off-site land-use impacts.

Tax revenue can affect land use because it enables local jurisdictions to be able to provide the public services (e.g., transportation and utilities) necessary to support development. Section 4.7.4.1 of the GEIS states that the assessment of tax-driven land-use impacts during the license renewal term should consider (1) the size of Exelon's payments relative to the community's total revenues, (2) the nature of the community's existing land-use patterns, and (3) the extent to which the community already has public services in place to support and guide development (NRC 1996). If Exelon's tax payments are projected to be SMALL relative to the community's total revenue, tax-driven land-use changes during Dresden's license renewal term would be SMALL, especially where the community has pre-established patterns of development and has provided adequate public services to support and guide development. Section 4.7.2.1 of the GEIS states that if tax payments by the plant owner are less than 10 percent of the taxing jurisdiction's revenue, the significance level would be SMALL. If Exelon's tax payments are projected to be MODERATE to LARGE relative to the community's total revenue, new tax-driven land-use changes would be MODERATE to LARGE (NRC 1996).

Exelon pays annual property taxes to Grundy and Will counties. Dresden property taxes provided between 13 and 20 percent ($9.3 million to $12.8 million) of Grundy County's total levee extension, and the same percentages of the county's total collections available for distribution between 1997 and 2000. Dresden is expected to contribute less of an overall percentage of Grundy County's tax base as the surrounding area continues to grow. In the case of Will County, Dresden property taxes provided less than 1 percent of total levee extension and collections available for distribution (Exelon 2003a). Therefore, the overall impact of Dresden taxes on Will and Grundy counties is considered SMALL. The continued operation during the relicensing period would result in continuing tax revenues, which is beneficial to the local community.

Exelon does not anticipate major refurbishment or construction during the license renewal period and, therefore, does not anticipate any increase in the assessed value of Dresden due to refurbishment-related improvements nor any related tax-increase-driven changes to off-site land-use and development patterns. If the operating license for Dresden was not renewed and the station was decommissioned, the impacts to the tax base of the surrounding communities and their economic structures could be significant, as discussed in Section 8.4.7 of the GEIS (NRC 1996). However, based on the information presented above, the staff concludes that tax-related land-use impacts related to renewing the operating license for Dresden are likely to be SMALL.

4.4.4 Public Services: Transportation Impacts During Operations

On October 4, 1999, 10 CFR 51.53(c)(3)(ii)(J) and 10 CFR Part 51, Subpart A, Appendix B, Table B-1 were revised to clearly state that "Public Services: Transportation Impacts During Operations" is a Category 2 issue (see NRC 1999b for more discussion of this clarification). The issue is treated as such in this SEIS.

Expected population growth in the area around the Dresden site is not due directly to increases in employment at Dresden Units 2 and 3. The permanent employment associated with Dresden Units 2 and 3 is currently about 990 employees (Exelon 2003a). During refueling outages, which occur about once a year, as many as 760 additional workers are hired on a temporary basis. The "upper bound" potential increase in permanent staff during the license renewal term is 60 additional workers, or approximately 6 percent of the current permanent and contract work force of approximately 990. The local employees do not regard the associated annual traffic increase as a problem (see Section 2.1.1.2). Based on these facts, Exelon concluded that the

impacts on transportation during the license renewal term would be SMALL, and that no further mitigation measures are warranted.

The staff reviewed Exelon's assumptions and resulting conclusions. The staff concludes that any impact of Dresden employees on transportation service degradation is likely to be SMALL and no further mitigation measures are warranted.

4.4.5 Historic and Archaeological Resources

The National Historic Preservation Act (NHPA) requires that Federal agencies take into account the effects of their undertakings on historic properties (16 USC 470 et seq.). The historic preservation review process mandated by Section 106 of the NHPA is outlined in regulations issued by the Advisory Council on Historic Preservation at 36 CFR Part 800 as amended through 2001. Renewal of an OL for a nuclear power plant is an undertaking that could potentially affect historic properties that may be located at the plant. Therefore, according to the NHPA, the NRC is to make a reasonable effort to identify historic properties in the areas of potential effects. If no historic properties are present or affected, the NRC is required to notify the State Historic Preservation Officer (SHPO) at the Illinois Historic Preservation Agency (IHPA) before proceeding. If it is determined that historic properties are present, the NRC is required to assess and resolve possible adverse effects of the undertaking.

Exelon initiated communication with the Illinois state historic preservation offices by letter dated January of 2002 (Jury 2002a). The letter expressed Exelon's desire to assess the effects of the license renewal on historic properties, as required by the NRC of applicants for operating license renewal. The letter specifically defined the undertaking at the DNPS site itself and five related transmission lines built to connect DNPS to the regional transmission system. The applicant notes in its letter that it does not expect the operation of DNPS, including maintenance of the identified transmission lines, through the license renewal term to adversely affect cultural or historical resources. The applicant further stated that "No major structural modifications have been identified for the purposes of supporting license renewal. Any maintenance activities necessary to support license renewal would be limited to previously disturbed areas. No additional land disturbance is anticipated in support of license renewal." Finally, a request is made in the letters for state concurrence with a determination that operations at DNPS during the period of the license renewal would have "…no effect on any historic or archeological properties" (Exelon 2003a).

| The Illinois Historic Preservation Agency (IHPA) responded in their January 30, 2002, letter that
| it had reviewed the documentation submitted by Exelon for the referenced project in
| accordance with regulations to implement Section 106 of the National Historic Preservation Act
| (36 CFR 800.4), and agreed that no historic properties are affected by the undertaking as
| described by the applicant (Exelon 2003a).

| The NRC forwarded letters to the Illinois Historic Preservation Agency (IHPA) for confirmation
| of their previous conclusion that no historic properties are affected by the decision to renew the
| DNPS operating licenses (NRC 2003 and 2004). In a letter dated February 24, 2004, IHPA
| concurred with the staff's determination that the impact of license renewal on historical and
| archaeological resources is small and that additional mitigation is not warranted (Haaker 2004).

Although no surveys have been conducted to date at the Dresden site, and the potential exists for significant cultural resources to be present within the site boundaries, it does not appear that the proposed license renewal will adversely affect cultural resources. The applicant has indicated that no refurbishment or replacement activities, including additional land-disturbing activities at the plant site or along existing transmission corridors, are planned for the license renewal period (Exelon 2003a). Therefore, continued operation of the Dresden Units 2 and 3 would likely protect any cultural resources present within the Dresden site boundary by protecting those lands from development and providing secured access. There is a potential for significant cultural resources to be present at the site, based on its location and the types of findings recorded nearby (e.g., the Briscoe Mounds). Therefore, when conducting normal
| operations and maintenance activities which could inadvertently affect cultural resources, the applicant should exercise appropriate care. Any ground-disturbing activity in an undisturbed
| area should be preceded by an evaluation of cultural resources in consultation with the IHPA and appropriate Native American tribes as required under Section 106 of the NHPA. During
| this environmental review, Exelon upgraded their procedures to include the following two provisions (Exelon 2003b):

- Contact the IHPA (SHPO) for guidance on requirements for an archaeological survey when any undertaking would disturb sediments at the station at depths below previous disturbance, or below the present surface in previously undisturbed areas. [Note: previous disturbance is defined by the documented disturbance area and depth for projects previously reviewed by the NRC and determined to be not significant. Areas or sediments that extend beyond these boundaries are previously undisturbed.]

- Once guidance is received from the IHPA, adhere to that guidance.

Based on the staff's review and the procedure changes implemented by the applicant, the impact of license renewal on historic and archaeological resources is SMALL and additional mitigation is not warranted.

4.4.6 Environmental Justice

Environmental justice refers to a Federal policy in which Federal actions should not result in disproportionately high and adverse impacts on minority[(a)] or low-income populations. Executive Order 12898 (59 FR 7629) directs Federal executive agencies to consider environmental justice under NEPA. The Council on Environmental Quality (CEQ) has provided guidance for addressing environmental justice (CEQ 1997). Although the Commission is not subject to the Executive Order, the Commission has voluntarily committed to undertake environmental justice reviews. Specific guidance is provided in the NRC Office of Nuclear Reactor Regulation Office Instruction LIC-203, *Procedural Guidance for Preparing Environmental Assessments and Considering Environmental Issues* (NRC 2001).

For the purpose of the staff's review, a minority population is defined to exist if the percentage of minorities within the census block groups[(b)] in each state within the 80 km (50 mi) potentially affected by the license renewal of Dresden Units 2 and 3, exceeds by 20 percentage points the corresponding percentage of minorities in the state of which it is a part, or if the corresponding percentage of minorities within the census block group is at least 50 percent. A low-income population is defined to exist if the percentage of low-income population within a census block group exceeds by 20 percentage points the corresponding percentage of low-income population in the state of which it is a part, or if the corresponding percentage of low-income population within a census block group is at least 50 percent. For census tract and block groups within Grundy and Will counties, for example, the percentage of minority and low-

(a) The NRC guidance for performing environmental justice reviews defines "minority" as American Indian or Alaskan Native, Asian, Native Hawaiian or other Pacific Islander, Black races, or Hispanic ethnicity. "Other" races and multiracial individuals may be considered as separate minorities (NRC 2001).

(b) A census block group is a combination of census blocks, which are statistical subdivisions of a census tract. A census block is the smallest geographic entity for which the U.S. Bureau of the Census (USBC) collects and tabulates decennial census information. A census tract is a small, relatively permanent statistical subdivision of counties delineated by local committees of census data users in accordance with USBC guidelines for the propuse of collecting and presenting decennial census data. Census block groups are subsets of census tracts (USBC 1999).

income populations is compared to the percentage of minority and low-income populations in Illinois overall.

The scope of the review as defined in NRC Guidance (NRC 2001) should include an analysis of impacts on minority and low-income populations, the location and the significance of any environmental impacts during operations on populations that are particularly sensitive, and any additional information pertaining to mitigation. The descriptions to be provided by this review should state whether these impacts are likely to be disproportionately high and adverse. The review should also evaluate the significance of such impacts.

The staff examined the geographic distribution of minority populations and low-income populations recorded during the 2000 census within 80 km (50 mi) of Dresden, encompassing 19 counties in Illinois (i.e., Bureau, Cook, DeKalb, DuPage, Ford, Grundy, Iroquois, Kane, Kankakee, Kendall, La Salle, Lee, Livingston, McLean, Marshall,Ogle, Putnam, Will, and Woodford), and two counties in Indiana (Lake and Newton). The analysis was also supplemented by inquiries to the planning department and social service agencies in Grundy and Will counties.[(a)]

Exelon conducted its analysis for minority and low-income populations using the convention of including a census tract or block group if any part of its area lay within 80 km (50 mi) of Dresden. Exelon used USBC 2000 census data to determine the minority characteristics on a block group level, but it used 1990 tract data for the low-income analysis because USBC 2000 low-income data was not available (Exelon 2003a). However, the NRC staff used USCB 2000 census data for the low-income analysis. Using these conventions, the 80-km (50-mi) radius included 1693 census tracts and 5503 block groups. The criterion of "more than 20 percentage points" was used to determine whether a census tract or block group should be counted as containing a minority or low-income population. Figures 4-1 and 4-2 show the distribution of census block groups for the minority and low-income populations, respectively (shaded areas).

Based on the criterion of "more than 20 percentage points greater," Exelon determined that Black minority populations exist in 1470 block groups; American Indian or Alaskan native minority populations exist in one block group; Asian minority populations exist in 83 block groups; Hispanic-ethnicity minority populations exist in 1004 block groups; and all other single minorities, multi-racial minorities, and aggregate of minority races exist in 2658 block groups

(a) Grundy and Will counties were the focus of the inquiry because all of both counties lie within the 80-km (50-mi) radius and are nearest the Dresden site. The staff concludes that any findings or environmental justice issues in these counties would warrant further field inquiries in more distant counties.

(Exelon 2003a). Figure 4-1 shows the locations of census block groups with minority populations.

By the NRC criteria (50 percent of population, or at least 20 percentage points greater than the state), eight counties in Illinois (Cook, DeKalb, DuPage, Iroquois, Kane, Kankakee, La Salle and Will) and one county in Indiana (Lake) contain census tracts within 80 km (50 mi) of Dresden that contain low-income populations. Figure 4-2 shows the locations of census tracts with low-income populations.

With the locations of minority and low-income populations identified, the staff proceeded to evaluate whether any of the environmental impacts of the proposed action could affect these populations in a disproportionate manner. Based on NRC guidance (NRC 2001), the staff examined air, land, and water resources within about 80 km (50 mi) of Dresden. Within that area, a few potential environmental impacts could affect human populations; all of these were considered SMALL for the general population. These include:

- Microbiological organisms (discussed in Section 4.1.4)
- Electric shock (discussed in Section 4.2.1)
- Groundwater-use conflicts (discussed in Section 4.5)
- Postulated accidents (discussed in Chapter 5 and Appendix G of this SEIS and Chapter 5 of the GEIS).

The pathways through which the environmental impacts associated with the Dresden Units 2 and 3 license renewal can affect human populations are discussed in each associated section. The staff then evaluated whether minority and low-income populations could be disproportionately affected by these impacts. The staff found no unusual resource dependencies or practices, such as subsistence agriculture, hunting, or fishing, through which the populations could be disproportionately affected. In addition, the staff did not identify any location-dependent disproportionate impacts affecting these minority and low-income populations. The staff concludes that off-site impacts from Dresden to minority and low-income populations would be SMALL, and that no further mitigation measures are warranted.

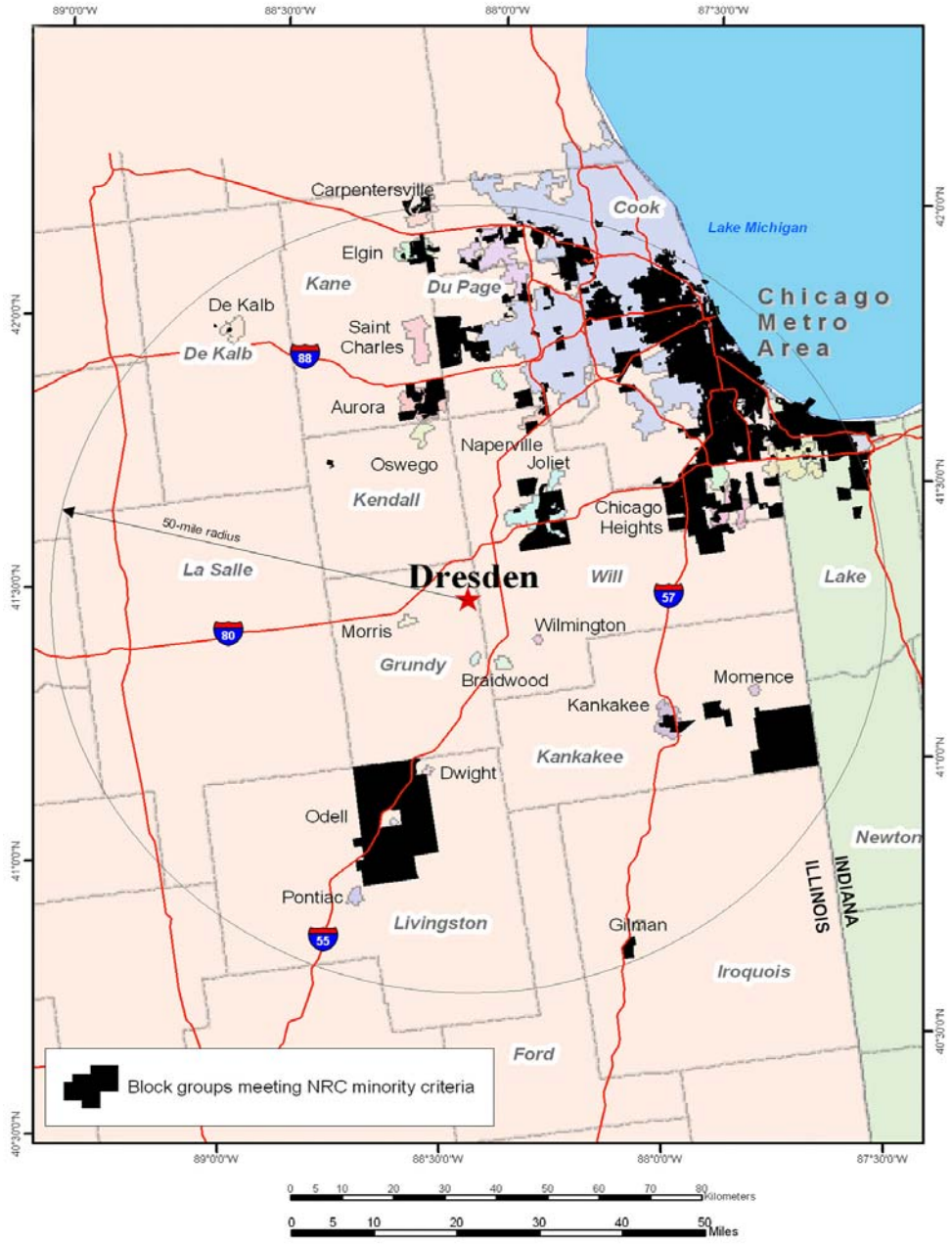

Figure 4-1. Geographic Distribution of Minority Populations (shown in shaded areas) Within 80 km (50 mi) of the Dresden Site Based on 2000 Census Block Group Data

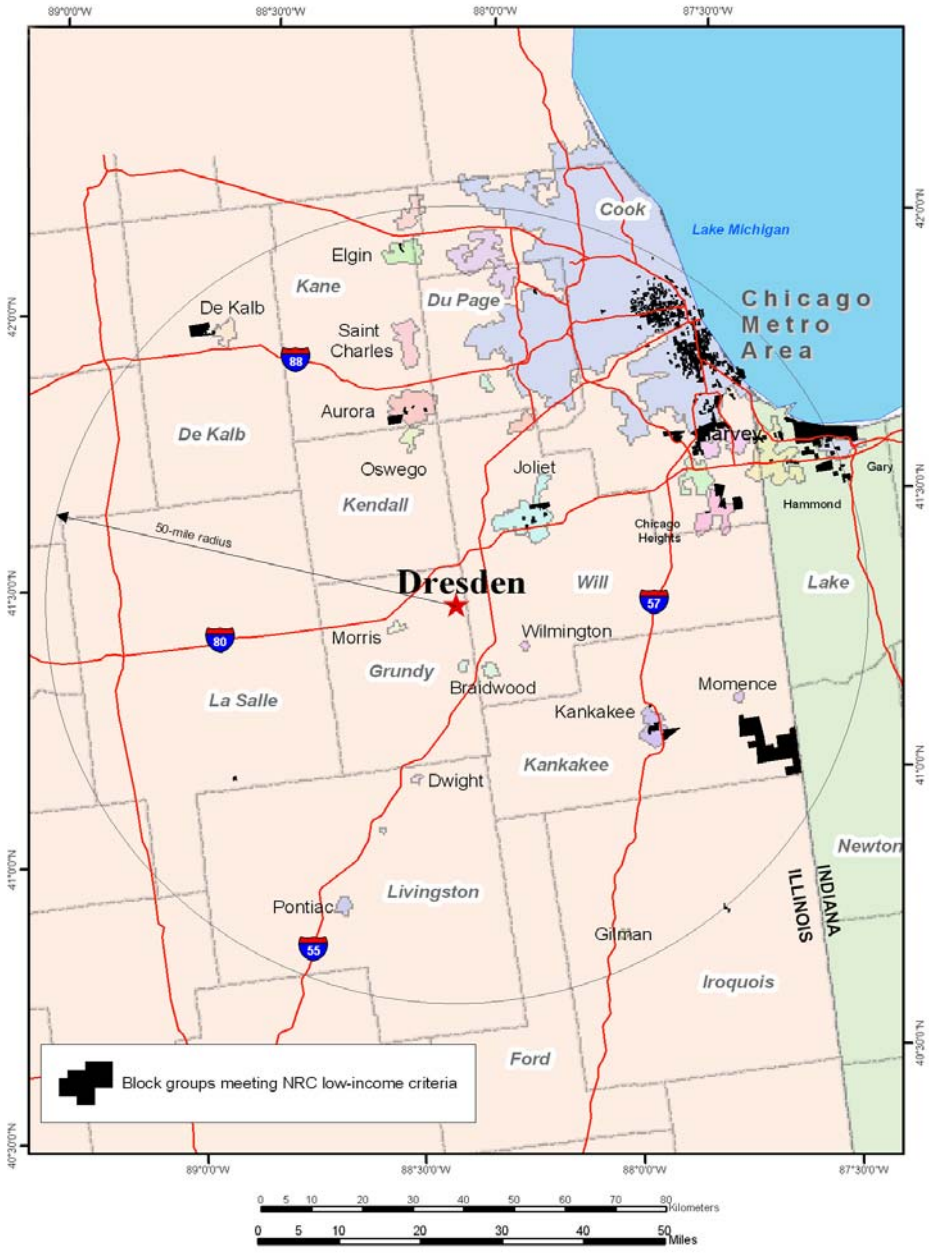

Figure 4-2. Geographic Distribution of Low-Income Populations (shown in shaded areas) Within 80 km (50 mi) of the Dresden Site Based on 2000 Census Block Group Data

4.5 Groundwater Use and Quality

Dresden is located within the Central Lowland Province that consists of a glaciated lowland stretching from the Appalachian Plateau on the east to the Great Plains on the west. Groundwater resources in the region are developed from four aquifer systems: the glacial drift aquifer (i.e., the alluvial aquifer), the shallow dolomite aquifer located mainly in Silurian rock, the Cambrian-Ordovician aquifer, and the Mt. Simon aquifer (AEC 1973). The alluvial aquifer is hydraulically connected to the cooling pond but is isolated from the Cambrian-Ordovician aquifer from which Dresden withdraws water (AEC 1973).

Dresden has three groundwater wells. During 2000, the two primary wells for plant operations, Wells 1 and 2, pumped at a combined average rate of 0.27 m^3/min (72 gpm). These wells are approximately 457 m (1500 ft) deep and provide processing, washing, cooling, condensing, boiler feed, and sanitary water for employees. Well 3 is 49 m (160 ft) deep and pumps up to 2 L/s (30 gpm); however, it is typically used only 10 minutes per day with an average daily yield of 0.8 L/min (0.2 gpm). This well supplies water for the wastewater treatment plant operation. Therefore, the total groundwater production rate for Dresden is approximately 0.27 m^3/min (72 gpm). Withdrawal of groundwater at this rate has not caused any conflicts in the past and is not anticipated to cause a conflict in the future. If a conflict were to arise in the future, alternative water supplies from surface water sources are available. Also, Dresden does not use Ranney wells; therefore, the issue of groundwater-use conflicts for plants using Ranney wells does not apply.

A Category 1 issue in 10 CFR Part 51, Subpart A, Appendix B, Table B-1, applicable to Dresden Units 2 and 3 groundwater use and quality is identified in Table 4-8. Exelon stated in its ER that it is not aware of any new and significant information associated with the renewal of the Dresden Units 2 and 3 OLs (Exelon 2003a). The staff has not identified any new and significant information during the staff's independent review of the Dresden ER (Exelon 2003a), the scoping process, the staff's site visit, the staff's evaluation of other available information, and public comments on the draft SEIS. Therefore, the staff concludes that there are no impacts related to this issue beyond those discussed in the GEIS. For this issue, the staff concludes that the impacts are SMALL, and that additional plant-specific mitigation measures are not likely to be sufficiently beneficial to be warranted.

Table 4-8. Category 1 Issue Applicable to Groundwater Use and Quality During the Renewal Term

ISSUE—10 CFR Part 51, Subpart A, Appendix B, Table B-1	GEIS Section
GROUNDWATER USE AND QUALITY	
Groundwater-use conflicts (potable and service water; plants that use <100 gpm).	4.8.1.1; 4.8.1.2

A brief description of the staff's review and the GEIS conclusions, as codified in Table B-1, follows:

- Groundwater-use conflicts (potable and service water; plants that use less than 100 gpm). Based on information in the GEIS, the Commission found that plants using less than 100 gpm are not expected to cause any groundwater-use conflicts.

As discussed below, Dresden site groundwater use is approximately 0.27 m^3/min (72 gpm) (less than 100 gpm). The staff has not identified any new and significant information during the staff's independent review of the Dresden ER (Exelon 2003a), the scoping process, the staff's site visit, the staff's evaluation of other available information, and public comments on the draft SEIS. Therefore, the staff concludes that there are no groundwater-use conflicts during the renewal term beyond those discussed in the GEIS.

There are two Category 2 issues related to groundwater use and quality that are applicable to Dresden Units 2 and 3 and require a site-specific assessment before license renewal. These issues are listed in Table 4-9 and discussed below.

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

One groundwater-use issue concerns plants that have cooling towers and withdraw makeup water from a small river. Surface-water withdrawals from small water bodies during low-flow conditions may result in groundwater-use conflicts with nearby groundwater users. The impact of consumptive loss on nearby groundwater users is associated with the difference it could potentially cause in aquifer recharge, especially if other new groundwater or upstream surface-water users begin withdrawals. Section 2.2.2 describes Dresden site surface water withdrawals from the Kankakee River. As described in Section 2.1.3, Dresden Units 2 and 3 normally operate with a once-through cooling system. However, because groundwater flows towards Kankakee River, groundwater withdrawals would not be impacted by changes in river flow.

Dresden pumps groundwater for use as potable water and is not connected to a municipal system. Seventy-two percent of the permanent employees of Dresden reside in Grundy and Will counties. At the present time, the water supply systems in Grundy and Will counties are operating substantially below their maximum capacities. At the current and proposed levels of operation, each community could absorb new employees without jeopardizing their water supplies.

The staff reviewed the relevant technical reports and the ER relative to potential groundwater-use conflicts due to consumptive loss of aquifer recharge. Based on this review, the staff has

Table 4-9. Category 2 Issues Applicable to Groundwater Use and Quality During the Renewal Term

ISSUE—10 CFR Part 51, Subpart A, Appendix B, Table B-1	GEIS Section	10 CFR 51.53(c)(3)(ii) Subparagraph	SEIS Section
GROUNDWATER USE AND QUALITY			
Ground-water-use conflicts (plants using cooling towers withdrawing makeup water from a small river)	4.8.1.3	A	4.5.1
Groundwater quality degradation (cooling ponds at inland sites)	4.8.3	D	4.5.2

concluded that the potential impacts are SMALL, and that no further mitigation measures are warranted.

4.5.2 Groundwater Quality Degradation (Cooling Ponds at Inland Sites)

A second groundwater-use issue concerns the use of cooling ponds at inland sites. Dresden, an inland site, has a cooling pond that covers about 516 ha (1275 ac), with an average depth of 3 m (10 ft). A five-year water quality study during the period 1969 to 1973 (ComEd 1974) found that there was little difference in water quality between the samples of water from the intake location and those from the cooling pond discharge. Another study in 1981 (ComEd 1981) found that during low flow periods of the Kankakee River when constituent concentration would be high, the discharge water from the cooling pond was of better quality than the intake water. This difference in water quality may be attributable to solids deposition in the cooling pond sediments, and it may have no contribution to groundwater quality. However, if there were any contribution or transfer of contaminants collected in the pond to groundwater, it would be to the glacial drift aquifer contiguous with the Kankakee River. Thus, some constituents from the river that are concentrated in the pond could return to the river by way of the glacial drift aquifer. Any impact to groundwater would be localized and would only affect a shallow aquifer that is not used for domestic water supply. The cooling pond is isolated from the Cambrian-Ordovician aquifer (AEC 1973), which is the source for municipal and industrial water in the area.

The staff reviewed the relevant technical documents and the Dresden ER relative to potential groundwater degradation due to the operation of a cooling pond. Based on this review, the staff has concludes that the potential impacts are SMALL, and that no further mitigation measures are warranted.

4.6 Threatened or Endangered Species

Threatened or endangered species are listed as a Category 2 issue in 10 CFR Part 51, Subpart A, Appendix B, Table B-1. This issue is listed in Table 4-10.

Table 4-10. Category 2 Issue Applicable to Threatened or Endangered Species During the Renewal Term

ISSUE—10 CFR Part 51, Subpart A, Appendix B, Table B-1	GEIS Section	10 CFR 51.53(c)(3)(ii) Subparagraph	SEIS Section
THREATENED OR ENDANGERED SPECIES (FOR ALL PLANTS)			
THREATENED OR ENDANGERED SPECIES	4.1	E	4.6

This issue requires consultation with appropriate agencies under Section 7 of the Endangered Species Act to determine whether Federally listed threatened or endangered species are present and whether they would be adversely affected by the continued operation of the nuclear power plant for an additional 20 years during the license renewal term. On January 11, 2002, Exelon corresponded with the FWS and requested information on the potential impacts of relicensing on Federally listed threatened and endangered species (Exelon 2002b). The FWS indicated that it had no objection to the relicensing action on February 12, 2002 (FWS 2002). On March 11, 2003, the NRC independently contacted the FWS to request information on threatened and endangered species and the impacts of relicensing (NRC 2003a). On August 11, 2003, the NRC notified the FWS that the scope of the transmission lines included in the environmental review had expanded. In response, on September 15, 2003, the FWS provided additional information regarding Federally listed species that have been observed or may occur in the vicinity of the Dresden site and its associated transmission lines (FWS 2003). The presence of Federally listed threatened or endangered species in the vicinity of the Dresden site is discussed in Sections 2.2.5 and 2.2.6 of this SEIS.

The staff has prepared a biological assessment evaluating the potential impacts on ten Federally listed aquatic and terrestrial threatened, endangered, or candidate species resulting from the operation of Dresden for an additional 20 years during the license renewal term. For these species, the staff concluded that the renewal of the Dresden licenses will either have no effect or is not likely to have an adverse effect. In a letter dated February 12, 2004, the staff transmitted its biological assessment to the FWS and requested concurrence on its determination (NRC 2004b). The FWS concurred with the staff's conclusions in a letter dated March 11, 2004 (FWS 2004). The staff's biological assessment and the letter of concurrence from the FWS are included in Appendix E of this SEIS.

4.6.1 Aquatic Species

The Hine's emerald dragonfly is the only Federally listed aquatic species that occurs in any of the counties containing the Dresden site or associated transmission line ROWs. All known occurrences of this species are within 4 km of the Des Plaines River upstream of the Dresden site and have not been found to occur on or in the vicinity of the Dresden site. Further information on the occurrence and life history of Hine's emerald dragonfly is presented in Section 2.2.5 of this SEIS.

By letter dated February 12, 2004, the staff submitted a biological assessment (BA) to the FWS that evaluated the impacts of operational and maintenance activities during the 20-year period of extended operation that could result from renewal of the Dresden Units 2 and 3 operating licenses (NRC 2004b). The BA specifically assessed ten Federally listed species, including Hine's emerald dragonfly, afforded protection under the Endangered Species Act of 1973, that could potentially inhabit the Dresden site or transmission line ROWs. The staff concluded that operational and maintenance activities associated with continued operation of Dresden Units 2 and 3 would have no effect on the Hine's emerald dragonfly during the 20-year period of extended operation. The FWS concurred with the staff's determination in a letter dated March 11, 2004 (FWS 2004). The staff's BA and the FWS letter of concurrence are provided in Appendix E of this SEIS.

The staff has reviewed the information provided by the applicant concerning aquatic endangered and threatened species that could be affected by continued operation and maintenance of Dresden Units 2 and 3 and associated transmission lines. No refurbishment activities are currently planned by the applicant and, therefore, disturbance of protected species or their habitats on the Dresden site is not anticipated. Current transmission line ROW maintenance practices favor native species and reduce the likelihood of adverse impacts to sensitive habitats (e.g., wetlands and streams) and any species that may be present within the ROW. Based on this information, the staff's conclusion is that the impact on endangered or threatened aquatic species of an additional 20 years of operation and maintenance of the Dresden Units 2 and 3 and associated transmission lines would be SMALL, and no further mitigation measures are warranted.

4.6.2 Terrestrial Species

Federally listed and candidate species that occur in counties traversed by transmission lines associated with Dresden Units 2 and 3 include the decurrent false aster, eastern prairie fringed orchid, lakeside daisy, leafy prairie clover, Mead's milkweed, prairie bush clover, Hine's emerald dragonfly, bald eagle, and Indiana bat. The eastern massasauga, a small rattlesnake, is a candidate for Federal listing and also has the potential to be found along portions of associated transmission line ROWs.

By letter dated February 12, 2004, the staff submitted a BA to the FWS that evaluated the impacts of operational and maintenance activities during the 20-year period of extended operation that could result from renewal of the Dresden Units 2 and 3 operating licenses (NRC 2004b). The BA specifically assessed ten Federally listed terrestrial species, afforded protection under the Endangered Species Act of 1973, that could potentially inhabit the Dresden site or transmission line ROWs. These species are associated with prairie, wetlands, or open water habitats and could occur in portions of the ROWs that cross these habitats. Although most of the land crossed by transmission lines are devoted to agriculture, several segments of the line cross natural areas that could contain suitable habitat for these species. The staff concluded that operational and maintenance activities associated with continued operation of Dresden Units 2 and 3 would have no effect on four of the species: the decurrent false aster, the leafy prairie-clover, the lakeside daisy, and the Hine's emerald dragonfly. The staff concluded that license renewal for Dresden "may affect, but is not likely to adversely affect" six species: the Mead's milkweed, the prairie bush clover, the eastern prairie fringed orchid, the eastern massasauga, the Indiana bat, and the bald eagle. The FWS concurred with the staff's determination in a letter dated March 11, 2004 (FWS 2004). The staff's BA and the FWS letter of concurrence are provided in Appendix E of this SEIS.

Current Exelon ROW management practices reduce the probability of impacts to these sensitive habitats and the species that are dependent on them. All activities in Goose Lake Prairie State Natural Area, Des Plaines Conservation Area, and Midewin National Tallgrass Prairie are planned in consultation with staff at these sites and must be approved prior to implementation. In general, ROWs through prairie habitat require little, if any, maintenance because of the absence of trees. Disturbance to wetlands habitats and stream crossings are avoided and would be limited to occasional tree trimming or removal needed to prevent contact with transmission lines (Cunningham 2003).

Exelon participates in "Project Habitat," an industry program that emphasizes ROW management practices that are compatible with wildlife and improve habitat for native species. Exelon has converted some portions of the transmission line corridors to native prairie-grass species (Exelon 2003a). On those lines associated with Dresden re-licensing, prairie has been established on a 4-km (2.5-mi) segment on the northern portion of the Electric Junction transmission line.

The staff has reviewed the information provided by the applicant concerning Federally listed endangered, threatened, and candidate terrestrial species that could be affected by continued operation and maintenance of Dresden Units 2 and 3 and associated transmission lines. No refurbishment activities are currently planned by the applicant and, therefore, disturbance of protected species or their habitats on the Dresden site is not anticipated. Current transmission line ROW maintenance practices favor native species and reduce the likelihood of adverse impacts to sensitive habitats (e.g., wetlands, streams) and any listed species that could be present within the ROWs. Based on this information, the staff's conclusion is that the impact on

endangered or threatened terrestrial species of an additional 20 years of operation and maintenance of the Dresden Units 2 and 3 and associated transmission lines would be SMALL, and that no further mitigation measures are warranted.

4.7 Evaluation of Potential New and Significant Information on Impacts of Operations During the Renewal Term

The staff has not identified significant new information on environmental issues listed in 10 CR Part 51, Subpart A, Appendix B, Table B-1, related to operation during the renewal term. The staff reviewed the discussion of environmental impacts associated with operation during the renewal term in the GEIS and conducted the staff's own independent review, including public scoping meetings, to identify issues with significant new information. Processes for identification and evaluation of new information are described in Section 1.2.2, License Evaluation Process.

4.8 Cumulative Impacts of Operations During the Renewal Term

The staff considered potential cumulative impacts during the evaluation of information applicable to each of the potential impacts of operations of Dresden Units 2 and 3 during the renewal term identified within the GEIS. For the purposes of this analysis, past actions were those related to the resources at the time of the plant licensing and construction, present actions are those related to the resources at the time of current operation of the power plant, and future actions are considered to be those that are reasonably foreseeable through the end of plant operation. Therefore, the analysis considers potential impacts through the end of the current license term as well as the 20-year renewal license term. The geographical area over which past, present, and future actions that could contribute to cumulative impacts is dependent on the type of action considered and is described below for each impacted area.

The impacts of the proposed action, as described in Section 4.0, are combined with other past, present, and reasonably foreseeable future actions at Dresden regardless of what agency (Federal or non-Federal) or person undertakes such other actions. These combined impacts are defined as “cumulative” in 40 CFR 1508.7 and include individually minor but collectively significant actions taking place over a period of time. It is possible that an impact that may be SMALL by itself could result in a MODERATE or LARGE impact when considered in combination with the impacts of other actions on the affected resource. Likewise, if a resource is regionally declining or imperiled, even a SMALL individual impact could be important if it contributes to or accelerates the overall resource decline.

4.8.1 Cumulative Impacts Resulting from Operation of the Plant Cooling System

For the purposes of this analysis, the geographic area considered for cumulative impacts resulting from operation of the Dresden Units 2 and 3 cooling system is the Illinois River, bounded by the dam at Dresden Island, and the confluence of the Des Plaines River with the Kankakee River, and the Kankakee River from the confluence with the Des Plaines River to a point immediately east of the Dresden cooling pond. As discussed in Section 4.1, the staff found no significant new information that would indicate that the conclusions regarding any of the cooling system-related Category 1 issues related to Dresden are inconsistent with the conclusions in the GEIS (NRC 1996). Additionally, the staff determined that none of the cooling system-related Category 2 issues is likely to have greater than a SMALL impact on local water quality and aquatic resources.

The cumulative effects of past actions have resulted in the existing conditions on local water quality and aquatic resources. Section 2.2 discusses the environmental impacts of the plant on the environment, including changes and modifications within the Illinois, Des Plaines, and Kankakee Rivers that have had the greatest effects on aquatic resources.
Thermal loading on the receiving waters has been acceptable in the past although the conditions have been marginal during rare periods of drought and hot weather. During past heat wave conditions, the temperature of the receiving water in the Illinois River was approximately the same as the effluent from Dresden Units 2 and 3. Should similar drought or heat wave conditions occur in the future, the biological effects of heat stress would occur even if there were no effluents from the Dresden plant. However, additional cooling towers have been installed to better manage thermal loading. Dresden can also operate at reduced capacity during hot summer months, thereby reducing releases of heated water to meet thermal discharge conditions in the NPDES permit. Based on past conditions and anticipated future operations, staff concludes that releases of heated water from the Dresden plant would not contribute to cumulative effects of heat stress in the Illinois River during future droughts or heat waves.

The river water supply is adequate to meet the needs of the facility for cooling purposes, even during the lowest historical flow rates. There are no cumulative impacts on water supply.

The staff, while preparing this assessment, assumed that other industrial, commercial, or public installations could be located in the general vicinity of the Dresden site prior to the end of Dresden Units 2 and 3 operations. The discharge of water to the Illinois River from these facilities would be regulated by the IEPA. The discharge limits are set considering the overall or cumulative impact of all of the other regulated activities in the area. Compliance with the CWA and its NPDES permits minimizes Dresden's cumulative effects on aquatic resources. Continued operation of Dresden Units 2 and 3 will require renewed discharge permits from the IEPA, which will address changing requirements so that cumulative water quality objectives are served. Therefore, the staff concludes that the potential cumulative impacts of cooling system

operation contributed by the continued operation of Dresden Units 2 and 3 will be SMALL, and that no further mitigation measures are warranted.

4.8.2 Cumulative Impacts Resulting from Continued Operation of the Transmission Lines

The continued operation of the electrical transmission facilities associated with relicensing of Dresden Units 2 and 3 was evaluated to determine if there is a potential for interactions with other past, present, and future actions that could result in adverse cumulative impacts to terrestrial resources (e.g., wildlife populations and the size and distribution of habitat areas), wetlands, floodplains, or aquatic resources. For the purposes of this analysis, the geographic area that encompasses the past, present, and foreseeable future actions that could contribute to adverse cumulative effects is the area within 80 km (50 mi) of the Dresden site as depicted in Figure 2-1.

As described in Section 4.2, the staff found no new and significant information indicating that the conclusions regarding any of the transmission line-related Category 1 issues related to Dresden Units 2 and 3 are inconsistent with the conclusions in the GEIS. The applicant uses vegetation management practices (Cunningham 2003) that are protective of wildlife and habitat resources, including floodplains and wetlands, to maintain its ROWs. Transmission line maintenance activities are not expected to alter wetland or floodplain hydrology or adversely affect vegetation characteristics of these habitats. Therefore, continued operation and maintenance of these ROWs is not likely to contribute to a regional decline in wetland or floodplain resources. The maintenance procedures ensure minimal disturbance to wildlife and, in some cases, improve the habitat within the ROWs relative to many of the surrounding land uses (Exelon 2003a).

Therefore, the staff has determined that the cumulative impacts of the continued operation of the transmission lines associated with Dresden will be SMALL, and that no further mitigation is warranted.

4.8.3 Cumulative Radiological Impacts

The EPA and the NRC established radiological dose limits for protection of the public and workers from both instantaneous and cumulative effects of exposure to radiation and radioactive materials. These dose limits are codified in 40 CFR Part 190 and 10 CFR Part 20. For the purpose of this analysis, the area within 80 km (50 mi) radius of the Dresdan site was included. As stated in Section 2.2.7, Exelon has conducted a radiological environmental monitoring program (REMP) around the Dresden site since 1974. The REMP measures radiation and radioactive materials from all sources, including Dresden. Additionally, in Sections 2.2.7 and 4.3, the staff concluded that impacts of radiation exposure to the public and workers (occupational) from operation of Dresden Units 2 and 3 during the renewal term are SMALL. Hence, the monitoring program and staff's conclusion considered cumulative impacts.

The NRC and the State of Illinois would regulate any reasonably foreseeable future actions in the vicinity of Dresden site that could contribute to cumulative radiological impacts.

Therefore, the staff concludes that cumulative radiological impacts of continued operations of Dresden would be SMALL, and that no further mitigation measures are warranted.

4.8.4 Cumulative Socioeconomic Impacts

Much of the analyses of socioeconomic impacts presented in Section 4.4 of this SEIS already incorporate cumulative impact analysis because the metrics used for quantification only make sense when placed in the total or cumulative context. For instance, the impact of the total number of additional housing units that may be needed can only be evaluated with respect to the total number that will be available in the impacted area. Therefore, the geographical area of the cumulative analysis varies, depending on the particular impact considered, and may depend on specific boundaries, such as taxation jurisdictions, or may be distance related, as in the case of environmental justice.

The continued operation of Dresden Units 2 and 3 is not likely to add to any cumulative socioeconomic impacts beyond those already evaluated in sections 4.4. In other words, the impacts of issues, such as transportation or off-site land use, are likely to be non-detectable beyond the regions previously evaluated and will quickly decrease with increasing distance from the site. The staff determined that the impacts on housing, public utilities, public services, and environmental justice would all be SMALL. The staff determined that the impact on off-site land use is SMALL because no refurbishment actions are planned at dresden, and no new incremental sources of plant-related tax payments are expected that could influence land use by fostering considerable growth. There are no reasonably foreseeable scenarios that would alter these conclusions in regard to cumulative impacts.

With regard to cultural resources, although no archaeological or architectural surveys have been conducted to date at the Dresden site, and the potential exists for significant cultural resources to be present within the site boundaries, it does not appear that the proposed license renewal will adversely affect cultural resources. The applicant has indicated that no refurbishment or replacement activities, including additional land-disturbing activities, at the plant site (or along existing transmission corridors) are planned for the license renewal period (Exelon 2003a). The applicant has also indicated that the decommissioning of Dresden Unit 1 will be completed at the same time as the decommissioning of Dresden Units 2 and 3 (Exelon 2003a). Therefore, continued operation of Dresden Units 2 and 3 would likely protect any cultural resources present within the Dresden site boundary by protecting those lands from development and providing secured access. However, because there is a strong potential for significant cultural resources to be present at the site (on the basis of its location and the types of archaeological sites recorded nearby—e.g., the Briscoe Mounds—and the history of the Dresden site itself with respect to Dresden Unit 1), care should be taken by the applicant during

normal operations and maintenance activities that could inadvertently affect cultural resources. Any ground-disturbing activity in an undisturbed area should be preceded by an evaluation of cultural resources in consultation with the IHPA and appropriate Native American tribes as required under Section 106 of the NHPA. Any plans to decommission Dresden Unit 1 prior to the termination of the OL for Dresden Units 2 and 3, must be preceded by a historic evaluation of Unit 1 and must undergo Section 106 consultation with the IHPA. On the basis of this analysis of cultural resources, the contribution to a cumulative impact on cultural resources by continued operation of Dresden Units 2 and 3 during the license renewal period as proposed (Exelon 2003a) is considered SMALL.

4.8.5 Cumulative Impacts on Groundwater Use and Quality

The Dresden site is located within the Central Lowland Province that consistes of a glaciated lowland stretching from the Appalachian Plateau on the east to the Great Plains on the west. Dresden is situated in a subdivision called the Kankakee Plain, a level to gently undulating plain near the intersection of the Des Plains and the Kankakee Rivers. Groundwater resources in the region are developed from four aquifer systems. These consist of the glacial drift aquifer, the shallow dolomite aquifer, the Cambrian-Ordovician aquifer, and the Mt. Simon aquifer (AEC 1973). The Cambrian-Ordovician aquifer is the main source of groundwater supply for municipal and industrial use in the area. The Dresden cooling pond is hydraulically connected to the glacial drift aquifer (an alluvial aquifer) but is isolated from the the Cambrian-Ordovician aquifer.

Dresden has three groundwater wells. Two are installed to depths of approximately 1500 ft below ground surface within the Cambrian-Ordovician aquifer (AEC 1973). The third well is installed to a depth of approximately 160 ft in the shallow dolomite aquifer. These wells provide water for processing, washing, boiler feed, and sanitary use. The total rate of use is about 72 gpm, which may be easily sustainable. This rate of use has not caused any adverse impacts with respect to local water availability. Although the groundwater supply is adequate at the present time, the facility could substitute surface-water supply for some of the facility needs, if required in the future.

A groundwater quality issue addresses the use of cooling ponds at inland sites and the potential impact of groundwater degradation. Dresden has a cooling pond covering about 516 ha (1275 ac), with an average depth of 3 m (10 ft). Studies to date indicate that there is little difference in water quality between samples of water at the intake location and from the cooling pond discharge although under low flow conditions, there can be some deposition of solids in the cooling pond sediments. However, if there is any contribution or transfer of constituents collected in the pond to groundwater, it would be to the glacial drift aquifer, which is contiguous with the Kankakee River. Thus, some constituents from the river, that are concentrated in the pond, could return to the river by way of the glacial drift aquifer, and there would not be any cumulative impact on groundwater quality. Any impact to groundwater would be localized and temporary, in a shallow aquifer that is not used for beneficial water supply. The cooling pond is

isolated from the Cambrian-Ordovician aquifer (AEC 1973), the source for municipal and industrial water in the area. On the basis of this analysis of groundwater impacts, the contribution to the cumulative impact on groundwater resources by continued operation of the Dresden Units 2 and 3 during the license renewal period as proposed (Exelon 2003a) is considered SMALL.

4.8.6 Cumulative Impacts on Threatened or Endangered Species

The geographic area considered in the analysis of potential cumulative impacts to threatened or endangered species includes those Illinois counties that contain the Dresden site and its associated transmission line ROWs (DuPage, Grundy, Kendall, La Salle, Livingston, Tazewell, Will, and Woodford counties). No critical habitat, as designated by the Endangered Species Act, occurs in the area affected by the Dresden site; therefore, cumulative impacts on critical habitats have not been addressed. As discussed in Sections 2.2.5 and 2.2.6, there are several threatened or endangered species that could occur within this area. The staff's determination, presented in Section 4.6, is that continued operation of Dresden Units 2 and 3 would have a SMALL impact on Federally listed species. The staff's findings have been documented in a biological assessment (included in Appendix E) and were forwarded to the FWS in a letter dated February 12, 2004 (NRC 2004b). The FWS concurred on the staff's BA in a letter dated March 11, 2004 (FWS 2004).

4.8.6.1 Aquatic Species

The Hine's emerald dragonfly is the only Federally listed aquatic species that may occur in the area of the Dresden site and its associated transmission lines. As discussed in Sections 2.2.5 and 4.6.1, the Hine's emerald dragonfly is associated with wetland habitats dominated by grass or sedges and fed by mineral sources (FWS 2001). This species could occur in portions of the ROWs that cross these habitats. As discussed in Sections 2.1.7, 4.6.1, and 4.6.2, Exelon ROW management practices (Cunningham 2003) favor native species and reduce the likelihood of adverse impacts to sensitive habitats (e.g., wetlands and streams) and any listed species that may be present within the ROW. These management practices are expected to remain effective for the foreseeable future and, therefore, the cumulative adverse impacts that could result from the continuation of transmission line ROW maintenance activities are not expected to noticeable.

Adverse impacts to Federally listed aquatic species resulting from continued operations of Dresden Units 2 and 3 are unlikely. Undeveloped portions of the Dresden site that could support listed species are not affected by ongoing plant operations and no refurbishment activities that could disturb these areas are planned. Consequently, continued operation of Dresden Units 2 and 3 is not expected to contribute to adverse cumulative impacts on Federally listed aquatic threatened or endangered species.

The staff has determined that the cumulative impacts to aquatic threatened or endangered species due to continued operation of Dresden Units 2 and 3 and associated transmission lines would be SMALL, and that no further mitigation measures are warranted.

4.8.6.2 Terrestrial Species

As described in the staff's biological assessment dated February 12, 2004, (included in Appendix E), nine Federally listed terrestrial species and one candidate for listing may occur in the area of the Dresden site and its associated transmission lines (NRC 2004b). These species (see Table 2-2) include the decurrent false aster, the eastern prairie fringed orchid, the lakeside daisy, the leafy prairie clover, the Mead's milkweed, the prairie bush clover, the Hine's emerald dragonfly, the bald eagle, and the Indiana bat. The eastern massasauga, a small rattlesnake, is a candidate for Federal listing.

Listed and candidate terrestrial species in the project area are associated with prairie, wetland, or open water habitats. These species could occur in portions of the ROWs that cross these habitats. Although most of the land crossed by transmission lines is devoted to agriculture, several segments of the line cross natural areas that could contain suitable habitat for these species. As discussed in Sections 2.1.7, 4.6.1, and 4.6.2, Exelon ROW management practices (Cunningham 2003) reduce the probability of impacts to these habitats and could benefit those listed species dependent on prairie habitat. These management practices are expected to be carried out for the foreseeable future and will continue to limit adverse cumulative impacts that could result from transmission line ROW maintenance activities.

Adverse impacts to Federally listed terrestrial species resulting from continued operations of Dresden Units 2 and 3 are unlikely. Undeveloped portions of the Dresden site that could support listed species are not affected by ongoing plant operations and no refurbishment activities that could disturb these areas are planned. Consequently, continued operation of Dresden Units 2 and 3 is not expected to contribute to adverse cumulative impacts on Federally listed terrestrial threatened or endangered species.

The staff has determined that the cumulative impacts to terrestrial threatened or endangered species due to continued operation of Dresden Units 2 and 3 and associated transmission lines would be SMALL, and that additional mitigation measures would not be warranted.

4.9 Summary of Impacts During the Renewal Term

Neither Exelon nor the staff is aware of information that is both new and significant related to any of the applicable Category 1 issues associated with the Dresden operation during the renewal term. Consequently, the staff concludes that the environmental impacts associated with these issues are bounded by the impacts described in the GEIS. For each of these issues, the GEIS concludes that the impacts would be SMALL and that additional plant-specific mitigation measures are not likely to be sufficiently beneficial to warrant implementation.

Plant-specific environmental evaluations were conducted for 14 Category 2 issues applicable to Dresden operation during the renewal term and for environmental justice and chronic effects of electromagnetic fields. For 14 issues and environmental justice, the staff concludes that the potential environmental impact of renewal term operations of Dresden would be of SMALL significance in the context of the standards set forth in the GEIS and that no further mitigation measures are warranted. In addition, the staff determined that a consensus has not been reached by appropriate Federal health agencies regarding chronic adverse effects from electromagnetic fields. Therefore, no evaluation of this issue is required.

4.10 References

10 CFR Part 20. Code of Federal Regulations, Title 10*, Energy,* Part 20, "Standards for Protection against Radiation."

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

36 CFR Part 800. Code of Federal Regulations, Title 36, *Parks, Forests, and Public Property,* Part 800, “Protection of Historic and Cultural Resources.”

40 CFR Part 190. Code of Federal Regulations, Title 40, *Protection of Environment,* Part 190, "Environmental Radiation Protection Standards for Nuclear Power Operations."

40 CFR Part 1508. Code of Federal Regulations, Title 40, *Protection of Environment,* Part 1508, "Terminology and Index."

59 FR 7629. Executive Order 12898. “Federal Actions to Address Environmental Justice in Minority and Low-Income Populations.” *Federal Register.* Vol. 59, No. 32, p. 7629. February 16, 1994.

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5.0 Environmental Impacts of Postulated Accidents

Environmental issues associated with postulated accidents are discussed in the *Generic Environmental Impact Statement for License Renewal of Nuclear Plants* (GEIS), NUREG-1437, Volumes 1 and 2 (NRC 1996; 1999).[(a)] The GEIS includes a determination of whether the analysis of the environmental issue could be applied to all plants and whether additional mitigation measures would be warranted. Issues are then assigned a Category 1 or a Category 2 designation. As set forth in the GEIS, Category 1 issues are those that meet all of the following criteria:

(1) The environmental impacts associated with the issue have been determined to apply either to all plants or, for some issues, to plants having a specific type of cooling system or other specified plant or site characteristic.

(2) Single significance level (i.e., SMALL, MODERATE, or LARGE) has been assigned to the impacts (except for collective offsite radiological impacts from the fuel cycle and from high-level waste and spent fuel disposal).

(3) Mitigation of adverse impacts associated with the issue has been considered in the analysis, and it has been determined that additional plant-specific mitigation measures are likely not to be sufficiently beneficial to warrant implementation.

For issues that meet the three Category 1 criteria, no additional plant-specific analysis is required unless new and significant information is identified.

Category 2 issues are those that do not meet one or more of the criteria for Category 1, and therefore, additional plant-specific review of these issues is required.

This chapter describes the environmental impacts from postulated accidents that might occur during the license renewal term.

5.1 Postulated Plant Accidents

Two classes of accidents are evaluated in the GEIS. These are design-basis accidents (DBAs) and severe accidents, as discussed below.

(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 Addendum 1.

5.1.1 Design-Basis Accidents

In order to receive NRC approval to operate a nuclear power facility, an applicant must submit a safety analysis report (SAR) as part of the application. The SAR presents the design criteria and design information for the proposed reactor and comprehensive data on the proposed site. The SAR also discusses various hypothetical accident situations and the safety features that are provided to prevent and mitigate accidents. The NRC staff reviews the application to determine whether the plant design meets the Commission's regulations and requirements and includes, in part, the nuclear plant design and its anticipated response to an accident.

DBAs are those accidents that both the licensee and the NRC staff evaluate to ensure that the plant can withstand normal and abnormal transients, and a broad spectrum of postulated accidents without undue hazard to the health and safety of the public. A number of these postulated accidents are not expected to occur during the life of the plant but are evaluated to establish the design basis for the preventive and mitigative safety systems of the facility. The acceptance criteria for DBAs are described in 10 CFR Part 50 and 10 CFR Part 100.

The environmental impacts of DBAs are evaluated during the initial licensing process, and the ability of the plant to withstand these accidents is demonstrated to be acceptable before issuance of the operating license (OL). The results of these evaluations are found in license documentation such as the staff's safety evaluation report (SER), the final environmental statement (FES), the licensee's updated final safety analysis report (UFSAR), and Section 5.1 of this supplemental environmental impact statement (SEIS). The licensee is required to maintain the acceptable design and performance criteria throughout the life of the plant, including any extended-life operation. The consequences for these events are evaluated for the hypothetical maximum exposed individual; as such, changes in the plant environment will not affect these evaluations. Because of the requirements that continuous acceptability of the consequences and aging management programs be in effect for license renewal, the environmental impacts as calculated for DBAs should not differ significantly from initial licensing assessments over the life of the plant, including the license renewal period. Accordingly, the design of the plant relative to DBAs during the extended period is considered to remain acceptable, and the environmental impacts of those accidents were not examined further in the GEIS.

The Commission has determined that the environmental impacts of DBAs are of SMALL significance for all plants because the plants were designed to successfully withstand these accidents. Therefore, for the purposes of license renewal, design-basis accidents are designated as a Category 1 issue in 10 CFR Part 51, Subpart A, Appendix B, Table B-1. The early resolution of the DBAs make them a part of the current licensing basis of the plant; the current licensing basis of the plant is to be maintained by the licensee under its current license

and, therefore, under the provisions of 10 CFR 54.30, is not subject to review under license renewal. This issue, applicable to Dresden, is listed in Table 5-1.

Table 5-1. Category 1 Issue Applicable to Postulated Accidents During the Renewal Term

ISSUE—10 CFR Part 51, Subpart A, Appendix B, Table B-1	GEIS Section
POSTULATED ACCIDENTS	
Design-basis accidents	5.3.2; 5.5.1

Based on information in the GEIS, the Commission found that

> The NRC staff has concluded that the environmental impacts of design-basis accidents are of small significance for all plants.

Exelon Generation Company, LLC (Exelon) stated in its Environmental Report (ER) (Exelon 2003a) that it is not aware of any new and significant information associated with the renewal of the Dresden OL. The staff has not identified any new and significant information during the staff's independent review of the Dresden ER (Exelon 2003a), the scoping process, the staff's site visit, the staff's evaluation of other available information, and public comments on the draft SEIS. Therefore, the staff concludes that there are no impacts of design-basis accidents during the renewal term beyond those discussed in the GEIS.

5.1.2 Severe Accidents

Severe nuclear accidents are those that are more severe than DBAs because they could result in substantial damage to the reactor core, whether or not there are serious offsite consequences. The GEIS assessed the impacts of severe accidents during the license renewal period, using the results of existing analyses and site-specific information to conservatively predict the environmental impacts of severe accidents for each plant during the renewal period.

Based on information in the GEIS, the Commission found that

> The probability weighted consequences of atmospheric releases, fallout onto open bodies of water, releases to ground water, and societal and economic impacts from

severe accidents are small for all plants. However, alternatives to mitigate severe accidents must be considered for all plants that have not considered such alternatives.

Therefore, the Commission has designated mitigation of severe accidents as a Category 2 issue in 10 CFR Part 51, Subpart A, Appendix B, Table B-1. This issue, applicable to Dresden, is listed in Table 5-2.

Table 5-2. Category 2 Issue Applicable to Postulated Accidents During the Renewal Term

ISSUE—10 CFR Part 51, Subpart A, Appendix B, Table B-1	GEIS Sections	10 CFR 51.53(c)(3)(ii) Subparagraph	SEIS Section
POSTULATED ACCIDENTS			
Severe Accidents	5.3.3; 5.3.3.2; 5.3.3.3; 5.3.3.4; 5.3.3.5; 5.4; 5.5.2	L	5.2

The staff has not identified any new and significant information during the staff's independent review of the Dresden ER (Exelon 2003a), the scoping process, the staff's site visit, the staff's evaluation of other available information, and public comments on the draft SEIS. Therefore, the staff concludes that there are no impacts of severe accidents beyond those discussed in the GEIS. However, in accordance with 10 CFR 51.53(c)(3)(ii)(L), the staff has reviewed severe accident mitigation alternatives (SAMAs) for Dresden. The results of the staff's review are discussed in Section 5.2.

5.2 Severe Accident Mitigation Alternatives (SAMAs)

10 CFR 51.53(c)(3)(ii)(L) requires that license renewal (LR) applicants consider alternatives to mitigate severe accidents if the staff has not previously evaluated SAMAs for the applicant's plant in an environmental impact statement (EIS) or related supplement or in an environmental assessment. The purpose of this consideration is to ensure that plant changes (i.e., hardware, procedures, and training) with the potential for improving severe accident safety performance are identified and evaluated. SAMAs have not been previously considered for Dresden; therefore, the remainder of Chapter 5 addresses those alternatives.

5.2.1 Introduction

This section presents a summary of the SAMA evaluation for Dresden conducted by Exelon and described in the ER (Exelon 2003a) and of the NRC's review of that evaluation. The details of

the review are described in the NRC staff evaluation that was prepared by the staff with contract assistance from Information Systems Laboratories, Inc. The entire evaluation is presented in Appendix G.

The SAMA evaluation for Dresden was a four-step process. In the first step, Exelon quantified the level of risk associated with potential reactor accidents using the plant-specific probabilistic risk assessment and other risk models.

The second step was the examination of the major risk contributors to identify areas where plant improvements might have the greatest chance to reduce risk. Then possible ways of reducing those risks were identified. Common ways of reducing risk are changes to components, systems, procedures, and training. Exelon identified 265 potential SAMAs. Using a set of screening criteria, the number of SAMAs requiring further consideration was reduced to 50. Preliminary cost estimates were made for these 50 SAMAs, and any SAMAs costing more than the maximum attainable benefit (discussed in Section 5.2.3) were removed from further consideration.

In the third step, the benefits and costs for the remaining candidate SAMAs were estimated. Estimates were made of how much each proposed SAMA could reduce risk. Those estimates were developed in terms of dollars in accordance with NRC guidance for performing regulatory analyses (NRC 1997). The costs of implementing the proposed SAMAs were also estimated.

Finally in the fourth step, the costs and benefits of each of the remaining SAMAs were compared to determine whether the SAMA was cost-beneficial, meaning the benefits of the SAMA were greater than the costs (a positive cost-benefit). In the final analysis, Exelon concluded that none of these 265 SAMAs were cost-beneficial for Dresden. However, the staff concluded that two of the SAMAs may be cost-beneficial.

Each of these four steps is discussed in more detail in the sections that follow.

5.2.2 Estimate of Risk

Exelon submitted an assessment of SAMAs for Dresden as part of the ER (Exelon 2003a). This assessment was based on the most recent Dresden Probabilistic Risk Assessment (PRA) (including the Level 1 and 2 analyses), a plant-specific offsite consequence analysis performed using the MELCOR Accident Consequence Code System (MACCS2)(essentially a Level 3 PRA model), and insights from the Dresden Individual Plant Examination (IPE) (ComEd 1996) and Individual Plant Examination of External Events (IPEEE) (ComEd 1997; 2000). The SAMA analysis is based on the most recent PRA model available at the time of the ER, referred to as the 2002 update. The scope of the Dresden PRA does not include external events. The

baseline core damage frequency (CDF) for Dresden is approximately 1.9 x 10^{-6} per year, based on internally-initiated events. Exelon did not include the contribution to CDF from external events in these estimates even though the risk from external events is significantly higher for Dresden than the risk from internal events. Exelon concluded that the existing IPEEE and fire evaluations had adequately identified potential plant improvements to address external events. The breakdown of CDF by initiating event/accident class is summarized in Table 5-3. Loss of offsite power and transients (such as a loss of turbine building closed cooling water) are the dominant contributors to the CDF.

Table 5-3. Dresden Core Damage Frequency

Initiating Event/Accident Class	CDF (Per Year)	% Contribution to CDF
Loss of Offsite Power (LOOP)[(a)] (dual-unit and single-unit)	$7.8x10^{-7}$	41
Transients	$6.3x10^{-7}$	34
Loss of Multiple DC Buses	$1.5x10^{-7}$	8
Loss-of-Coolant Accident (LOCA)	$1.1x10^{-7}$	6
Internal Flooding	$5.7x10^{-8}$	3
Manual Shutdown	$5.7x10^{-8}$	3
Others	$5.7x10^{-8}$	3
Loss of Service Water	$3.8x10^{-8}$	2
Interfacing Systems LOCA (ISLOCA)	$1.9x10^{-9}$	0.1
Total CDF (from internal events)	**$1.9x10^{-6}$**	**100**

(a) Includes station blackout (SBO)

Table 5-4. Breakdown of Population Dose by Containment Release Mode

Containment Release Mode	Population Dose (Person-Rem[a] Per Year)	% Contribution
Early containment failure	8.04	79
Late containment failure	2.14	21
Containment Bypass	0.05	<1
No Containment Failure	~0	~0
Total Population Dose	**10.23**	**100**

(a) One person-rem = 0.01 person-Sv

Exelon estimated the dose from all postulated accidents to the population within 80 km (50 mi) of the Dresden site to be approximately 0.1023 person-Sv (10.23 person-rem). The breakdown of the population dose by containment release mode is summarized in Table 5-4. Early and late containment failures dominate the population dose.

The staff has reviewed Exelon's data and evaluation methods and concludes that the quality of the risk analyses is adequate to support an assessment of the risk reduction potential for the candidate SAMAs. Accordingly, the staff based its assessment of offsite risk on the CDF and offsite doses provided by Exelon.

5.2.3 Potential Plant Improvements

Once the most risk significant parts of the plant design and operation were identified, Exelon searched for ways to reduce those risks. To identify potential plant improvements, Exelon reviewed improvements identified in the Dresden IPE and IPEEE and subsequent PRA revision processes, SAMA analyses submitted for other nuclear power plants, and NRC and industry documents discussing potential plant improvements. Exelon identified 265 potential risk-reducing improvements to plant components, systems, procedures, and training (SAMAs).

All but 50 of these SAMAs were removed from further consideration because: (1) the SAMA was not applicable at Dresden due to design differences, (2) the SAMA had already been implemented at Dresden, (3) the SAMA was sufficiently similar to other SAMAs and was combined with another SAMA, or (4) the SAMA would not provide a significant safety benefit or has implementation costs greater than any possible risk benefit. A preliminary cost estimate was prepared for each of the remaining 50 SAMAs.

The preliminary cost estimate of each of these 50 remaining SAMAs was compared to the maximum attainable benefit (MAB) of 456 thousand dollars. The MAB is the dollar value of the benefit that would be achieved if the plant risk and population dose from postulated accidents

could be reduced to zero. If the cost of a SAMA exceeded the MAB, it could not be cost-beneficial because no single SAMA could eliminate all the risk. Using this comparison, all but 10 of the candidate SAMAs were removed from further consideration. In response to a request for additional information by the staff concerning the impact of external events and uncertainties on the SAMA identification process (NRC 2003), Exelon re-evaluated the SAMAs using a MAB of two million dollars (Exelon 2003b). Based on the re-evaluation, Exelon identified a total of 12 candidate SAMAs for further examination (the 10 SAMAs identified through the original screening, plus 2 additional SAMAs identified through the re-screening).

The staff reviewed Exelon's screening methods and results and concluded that they were systematic and comprehensive.

5.2.4 Evaluation of Risk Reduction and Costs of Improvements

Exelon evaluated the risk reduction potential of the remaining 12 SAMAs. Bounding calculations were made for most of these SAMAs; bounding calculations overestimate the benefit and are conservative. The benefits—the estimated dollar value of these risk reductions—were developed by calculating and adding the averted public exposure, offsite property damage, occupational exposure, and onsite costs associated with each SAMA (Exelon 2003a & b).

The staff reviewed Exelon's bases for calculating the risk reduction for the various plant improvements and concluded that the rationale and assumptions for estimating risk reduction are reasonable and generally conservative. Therefore, the staff based its estimates of averted risk for the various SAMAs on Exelon's risk reduction estimates. However, the staff concluded that the benefit estimates should be increased by a factor of five to account for the potential impacts of external events.

The staff reviewed the cost estimates and concluded that the cost ranges provided by Exelon were reasonable and appropriate for use in the SAMA evaluation.

5.2.5 Cost-Benefit Comparison

For the 12 candidate SAMAs identified through the screening process, a more detailed assessment and cost estimate were developed. Exelon applied a multiplier of five to the averted cost estimates (for internal events) for each SAMA, and characterized the result as an upper bound averted cost estimate. Based on a comparison of averted costs and potential implementation costs, four of the SAMAs were retained for further analysis. Exelon re-examined each of these SAMAs to ensure that the averted cost estimates from the internal

events analysis appropriately represent the potential (realistic) benefit rather than the maximum benefit, and revised the estimated averted costs and implementation costs accordingly. As a result of this reassessment, the cost-benefit analysis showed that none of the candidate SAMAs were cost-beneficial. Therefore, Exelon's final conclusion was that there were no cost-beneficial SAMAs (Exelon 2003b).

The staff reviewed Exelon's calculation methods and logic arguments in the final cost-benefit comparisons and concluded that Exelon's original benefit estimates should be increased by a factor of five to account for the potential impact of external events. Based on this evaluation, and the use of realistic estimates of averted costs and implementation costs, none of the SAMAs appear to be cost-beneficial. However, two SAMAs could be cost-beneficial given a more detailed evaluation of the external events benefits or when uncertainties are taken into account: SAMA 3b, development of procedures to use a cross connect to the other unit's low pressure coolant injection system as an alternate source of water for containment spray; and SAMA 11, procedural changes to align low pressure coolant injection or core spray to the condensate storage tank on loss of suppression pool cooling.

5.2.6 Conclusions

The staff reviewed the Exelon SAMA analysis and concluded that the methods used and the implementation of those methods were sound. The treatment of SAMA benefits and costs, the generally large negative net benefits, and the inherently small baseline risks support the general conclusion that the SAMA evaluations performed by Exelon are reasonable and sufficient for the license renewal submittal. However, the staff concluded that two SAMAs could be cost-beneficial given a more detailed evaluation of the external events benefits or when uncertainties are taken into account: SAMA 3b, development of procedures to use a cross connect to the other unit's low pressure coolant injection system as an alternate source of water for containment spray; and SAMA 11, procedural changes to align low pressure coolant injection or core spray to the condensate storage tank on loss of suppression pool cooling. However, these SAMAs do not relate to adequately managing the effects of aging during the period of extended operation. Therefore, they need not be implemented as part of license renewal pursuant to 10 CFR Part 54. Exelon has not made any commitment to implement these two SAMAs.

The staff concludes that none of the other candidate SAMAs are cost-beneficial. This conclusion is consistent with the low residual level of risk indicated in the Dresden PRA and the fact that Dresden has already implemented many plant improvements identified from the IPE and IPEEE process.

5.3 References

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

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

10 CFR Part 54. Code of Federal Regulations, Title 10, *Energy*, Part 54, "Requirements for Renewal of Operating Licenses for Nuclear Power Plants."

10 CFR Part 100. Code of Federal Regulations, Title 10, *Energy*, Part 100, "Reactor Site Criteria."

Commonwealth Edison Company (ComEd). 1996. Letter from John B. Hosmer, ComEd, to U.S. NRC Document Control Desk. Subject: Dresden Station Units 2 and 3, Response to NRC Review of Individual Plant Examination Submittal – Internal Events, NRC Docket Nos. 50-237 and 50-249, June 28, 1996.

Commonwealth Edison Company (ComEd). 1997. Letter from J. M. Heffley, ComEd, to U.S. NRC Document Control Desk. Subject: Dresden Nuclear Power Station Units 2 and 3 Final Report—Individual Plant Examination of External Events (IPEEE) Generic Letter 88-20, Supplement 4, December 30, 1997.

Commonwealth Edison Company (ComEd). 2000. Letter from Preston Swafford, ComEd, to U.S. NRC Document Control Desk. Subject: Dresden Nuclear Power Station, Units 2 and 3, Facility Operating License Nos. DPR-19 and DPR-25, NRC Docket Nos. 50-237 and 50-249, Request for Additional Information Regarding Individual Plant Examination of External Events, March 30, 2000.

Exelon Generation Company, LLC (Exelon). 2003a. *Applicant's Environmental Report – Operating License Renewal Stage, Dresden Nuclear Power Station Units 2 and 3.* Exelon Generation Company, LLC, Warrenville, Illinois. January 2003.

Exelon Generation Company, LLC (Exelon). 2003b. Letter from Patrick R. Simpson, Exelon, to U.S. NRC Document Control Desk. Subject: Dresden Nuclear Power Station, Units 2 and 3, Facility Operating License Nos. DPR-19 and DPR-25, NRC Docket Nos. 50-237 and 50-249, Response to Request for Additional Information – License Renewal Environmental Report for Dresden Nuclear Power Station, Units 2 and 3, July 23, 2003.

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U.S. Nuclear Regulatory Commission (NRC). 1997. *Regulatory Analysis Technical Evaluation Handbook*. NUREG/BR-0184, Washington, D.C.

U.S. Nuclear Regulatory Commission (NRC). 1999. *Generic Environmental Impact Statement for License Renewal of Nuclear Plants, Main Report*, "Section 6.3 – Transportation, Table 9.1, Summary of findings on NEPA issues for license renewal of nuclear power plants, Final Report." NUREG-1437, Volume 1, Addendum 1, Washington, D.C.

U.S. Nuclear Regulatory Commission (NRC). 2003. Letter from Louis L. Wheeler, U.S. Nuclear Regulatory Commission to John Skolds, Exelon. Subject: Request for Additional Information (RAI) Related to the Staff's Review of the License Renewal Environmental Report for the Dresden Nuclear Power Station, Units 2 and 3, May 23, 2003.

6.0 Environmental Impacts of the Uranium Fuel Cycle and Solid Waste Management

Environmental issues associated with the uranium fuel cycle and solid waste management are discussed in the *Generic Environmental Impact Statement for License Renewal of Nuclear Plants* (GEIS), NUREG-1437, Volumes 1 and 2 (NRC 1996; 1999).[(a)] The GEIS includes a determination of whether the analysis of the environmental issue could be applied to all plants and whether additional mitigation measures would be warranted. Issues are then assigned a Category 1 or a Category 2 designation. As set forth in the GEIS, Category 1 issues are those that meet all of the following criteria:

(1) The environmental impacts associated with the issue have been determined to apply either to all plants or, for some issues, to plants having a specific type of cooling system or other specified plant or site characteristic.

(2) A single significance level (i.e., SMALL, MODERATE, or LARGE) has been assigned to the impacts (except for collective off-site radiological impacts from the fuel cycle and from high-level waste [HLW] and spent fuel disposal).

(3) Mitigation of adverse impacts associated with the issue has been considered in the analysis, and it has been determined that additional plant-specific mitigation measures are likely not to be sufficiently beneficial to warrant implementation.

For issues that meet the three Category 1 criteria, no additional plant-specific analysis is required unless new and significant information is identified.

Category 2 issues are those that do not meet one or more of the criteria for Category 1 and, therefore, additional plant-specific review of these issues is required.

This chapter addresses the issues that are related to the uranium fuel cycle and solid waste management during the license renewal term that are listed in Table B-1 of 10 CFR Part 51, Subpart A, Appendix B, and are applicable to Dresden Units 2 and 3. The generic potential impacts of the radiological and nonradiological environmental impacts of the uranium fuel cycle and transportation of nuclear fuel and wastes are described in detail in the GEIS, based, in part, on the generic impacts provided in 10 CFR 51.51(b), Table S-3, “Table of Uranium Fuel Cycle Environmental Data,” and in 10 CFR 51.52(c), Table S-4, “Environmental Impact of

(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.

Transportation of Fuel and Waste to and from One Light-Water-Cooled Nuclear Power Reactor." The staff also addresses the impacts from radon-222 and technetium-99 in the GEIS.

6.1 The Uranium Fuel Cycle

Category 1 issues in 10 CFR Part 51, Subpart A, Appendix B, Table B-1, that are applicable to Dresden Units 2 and 3 from the uranium fuel cycle and solid waste management are listed in Table 6-1.

In its Environmental Report (ER), Exelon Generation Company, LLC (Exelon) stated that it is not aware of any new and significant information associated with the renewal of the Dresden Units 2 and 3 operating licenses (Exelon 2003). The staff has not identified any new and significant information during the staff's independent review of the Dresden ER (Exelon 2003a), the scoping process, the staff's site visit, the staff's evaluation of other available information, and public comments on the draft SEIS. Therefore, the staff concludes that there are no impacts related to these issues beyond those discussed in the GEIS. For these issues, the staff concluded in the GEIS that the impacts are SMALL except for the collective off-site radiological impacts from the fuel cycle and from HLW and spent fuel disposal, as discussed below, and that additional plant-specific mitigation measures are not likely to be sufficiently beneficial to be warranted.

A brief description of the staff review and the GEIS conclusions, as codified in Table B-1, 10 CFR Part 51, for each of these issues follows:

- Off-site radiological impacts (individual effects from other than the disposal of spent fuel and high-level waste). Based on information in the GEIS, the Commission found that

  > Off-site impacts of the uranium fuel cycle have been considered by the Commission in Table S-3 of this part (10 CFR 51.51[b]). Based on information in the GEIS, impacts on individuals from radioactive gaseous and liquid releases, including radon-222 and technetium-99, are small.

  The staff has not identified any new and significant information during the staff's independent review of the Dresden ER (Exelon 2003a), the scoping process, the staff's site visit, the staff's evaluation of other available information, and public comments on the draft SEIS. Therefore, the staff concludes that there are no off-site radiological impacts of the uranium fuel cycle during the renewal term beyond those discussed in the GEIS.

The staff has not identified any new and significant information during the staff's independent review of the Dresden ER (Exelon 2003a), the scoping process, the staff's site visit, the staff's evaluation of other available information, and public comments on the draft SEIS. Therefore, the staff concludes that there are no off-site radiological impacts of the uranium fuel cycle during the renewal term beyond those discussed in the GEIS.

Table 6-1. Category 1 Issues Applicable to the Uranium Fuel Cycle and Solid Waste Management During the Renewal Term

ISSUE—10 CFR Part 51, Subpart A, Appendix B, Table B-1	GEIS Section
URANIUM FUEL CYCLE AND WASTE MANAGEMENT	
Off-site radiological impacts (individual effects from other than the disposal of spent fuel and high-level waste)	6.1; 6.2.1; 6.2.2.1; 6.2.2.3; 6.2.3; 6.2.4; 6.6
Off-site radiological impacts (collective effects)	6.1; 6.2.2.1; 6.2.3; 6.2.4; 6.6
Off-site radiological impacts (spent fuel and high-level waste)	6.1; 6.2.2.1; 6.2.3; 6.2.4; 6.6
Nonradiological impacts of the uranium fuel cycle	6.1; 6.2.2.6; 6.2.2.7; 6.2.2.8; 6.2.2.9; 6.2.3; 6.2.4; 6.6
Low-level waste storage and disposal	6.1; 6.2.2.2;6.4.2; 6.4.3; 6.4.3.1; 6.4.3.2; 6.4.3.3; 6.4.4; 6.4.4.1; 6.4.4.2; 6.4.4.3; 6.4.4.4; 6.4.4.5; 6.4.4.5.1; 6.4.4.5.2; 6.4.4.5.3; 6.4.4.5.4; 6.4.4.6;6.6
Mixed waste storage and disposal	6.4.5.1; 6.4.5.2; 6.4.5.3; 6.4.5.4; 6.4.5.5; 6.4.5.6; 6.4.5.6.1; 6.4.5.6.2; 6.4.5.6.3; 6.4.5.6.4; 6.6
On-site spent fuel	6.1; 6.4.6; 6.4.6.1; 6.4.6.2; 6.4.6.3; 6.4.6.4; 6.4.6.5; 6.4.6.6; 6.4.6.7; 6.6
URANIUM FUEL CYCLE AND WASTE MANAGEMENT	
Nonradiological waste	6.1; 6.5; 6.5.1; 6.5.2; 6.5.3; 6.6
Transportation	6.1; 6.3.1; 6.3.2.3; 6.3.3;

- Off-site radiological impacts (collective effects). Based on information in the GEIS, the Commission found that

  > The 100-year-environmental-dose commitment to the United States population from the fuel cycle, HLW, and spent fuel disposal excepted, is calculated to be about 14,800 person-rem (148 person Sv), or 12 cancer fatalities, for each additional 20-year power-reactor operating term. Much of this, especially the contribution of radon releases from mines and tailing piles, consists of tiny doses summed over large populations. This same dose calculation can theoretically be extended to include many tiny doses over additional thousands of years as well as doses outside the United States. The result of such a calculation would be thousands of cancer fatalities from the fuel cycle, but this result assumes that even tiny doses have some statistical adverse health effect that will not ever be mitigated (for example, no cancer cure in the next thousand years), and that these doses projected over thousands of years are meaningful. However, these assumptions are questionable. In particular, science cannot rule out the possibility that there will be no cancer fatalities from these tiny doses. For perspective, the doses are very small fractions of regulatory limits and even smaller fractions of natural background exposure to the same populations.
  >
  > Nevertheless, despite all the uncertainty, some judgment about the regulatory National Environmental Policy Act (NEPA) implications of these matters should be made, and it is nonsensical to repeat the same judgment in every case. Even taking the uncertainties into account, the Commission concludes that these impacts are acceptable in that these impacts would not be sufficiently large to require the NEPA conclusion, for any plant, that the option of extended operation under 10 CFR Part 54 should be eliminated. Accordingly, while the Commission has not assigned a single level of significance for the collective effects of the fuel cycle, this issue is considered Category 1.

The staff has not identified any new and significant information during the staff's independent review of the Dresden ER (Exelon 2003a), the scoping process, the staff's site visit, the staff's evaluation of other available information, and public comments on the draft SEIS. Therefore, the staff concludes that there are no off-site radiological impacts (collective effects) from the uranium fuel cycle during the renewal term beyond those discussed in the GEIS.

- Off-site radiological impacts (spent fuel and HLW disposal). Based on information in the GEIS, the Commission found that

  For the HLW and spent fuel disposal component of the fuel cycle, there are no current regulatory limits for off-site releases of radionuclides for the current candidate repository site. However, if we assume that limits are developed along the lines of the 1995 National Academy of Sciences (NAS) report, "Technical Bases for Yucca Mountain Standards," and that in accordance with the Commission's Waste Confidence Decision, 10 CFR 51.23, a repository can and likely will be developed at some site which will comply with such limits, peak doses to virtually all individuals will be 100 millirems (mrem) (1 millisieverts [mSv]) per year or less. However, although the Commission has reasonable confidence that these assumptions will prove correct, there is considerable uncertainty because the limits are yet to be developed, no repository application has been completed or reviewed, and uncertainty is inherent in the models used to evaluate possible pathways to the human environment. The NAS report indicated that 100 mrem (1 mSv) per year should be considered as a starting point for limits for individual doses, but it notes that some measure of consensus exists among national and international bodies that the limits should be a fraction of the 100 mrem (1 mSv) per year. The lifetime individual risk from 100 mrem (1 mSv) annual dose limit is about 3×10^{-3}.

  Estimating cumulative doses to populations over thousands of years is more problematic. The likelihood and consequences of events that could seriously compromise the integrity of a deep geologic repository were evaluated by the Department of Energy in the "Final Environmental Impact Statement: Management of Commercially Generated Radioactive Waste," October 1980 (U.S. Department of Energy [DOE 1980]). The evaluation estimated the 70-year whole-body dose commitment to the maximum individual and to the regional population that resulted from several modes of breaching a reference repository in the year of closure, after 1000 years, after 100,000 years, and after 100 million years. Subsequently, the NRC and other federal agencies have expended considerable effort to develop models for the design and for the licensing of a HLW repository, especially for the candidate repository at Yucca Mountain. More meaningful estimates of doses to population may be possible in the future as more is understood about the performance of the proposed Yucca Mountain repository. Such estimates would involve very great uncertainty, especially with respect to cumulative population doses over thousands of years. The standard proposed by the NAS is a limit on maximum individual dose. The relationship of potential new regulatory requirements, based on the NAS report, and cumulative

population impacts has not been determined, although the report articulates the view that protection of individuals will adequately protect the population for a repository at Yucca Mountain. However, EPA's generic repository standards in 40 CFR Part 191 generally provide an indication of the order of magnitude of cumulative risk to population that could result from the licensing of a Yucca Mountain repository, assuming the ultimate standards will be within the range of standards now under consideration. The standards in 40 CFR Part 191 protect the population by imposing "containment requirements" that limit the cumulative amount of radioactive material released over 10,000 years. Reporting performance standards that will be required by EPA are expected to result in releases and associated health consequences in the range between 10 and 100 premature cancer deaths with an upper limit of 1000 premature cancer deaths worldwide for a 100,000 metric tonne (MT) repository.

Nevertheless, despite all the uncertainty, some judgment as to the regulatory NEPA implications of these matters should be made and it makes no sense to repeat the same judgment in every case. Even taking the uncertainties into account, the Commission concludes that these impacts are acceptable in that these impacts would not be sufficiently large to require the NEPA conclusion, for any plant, that the option of extended operation under 10 CFR Part 54 should be eliminated. Accordingly, while the Commission has not assigned a single level of significance for the impacts of spent fuel and HLW disposal, this issue is considered Category 1.

Since the GEIS was originally issued in 1996, the EPA has published radiation protection standards for Yucca Mountain, Nevada, at 40 CFR Part 197, "Public Health and Environmental Radiation Protection Standards for Yucca Mountain, Nevada," on June 13, 2001 (66 FR 32132). The Energy Policy Act of 1992 (42 USC 10101 et seq.) directs that the NRC adopt these standards into its regulations for reviewing and licensing the repository. The NRC published its regulations at 10 CFR Part 63, on November 2, 2001 (66 FR 55792). These standards include the following: (1) 0.15-mSv/yr (15-mrem/yr) dose limit for members of the public during the storage period prior to repository closure; (2) 0.15-mSv/yr (15-mrem/yr) dose limit for the reasonably maximally exposed individual for 10,000 years following disposal; (3) 0.15-mSv/yr (15-mrem/yr) dose limit for the reasonably maximally exposed individual as a result of a human intrusion at or before 10,000 years after disposal; and (4) a groundwater protection standard that states for 10,000 years of undisturbed performance after disposal, radioactivity in a representative volume of ground water will not exceed (a) 0.19 becquerels per

liter (Bq/L) (5 picocuries per liter [pCi/L]) radium-226 and radium-228, (b) 0.56 Bq/L (15 pCi/L) (gross alpha activity), and (c) 0.04 mSv/yr (4 mrem/yr) to the whole body or any organ (from combined beta and photon emitting radionuclides).

On July 23, 2002, the President signed into law House Joint Resolution 87 (Pub. L. No. 107-200) designating Yucca Mountain site as the repository for spent nuclear fuel. This development does not cause the staff to change its position with respect to the impact of spent fuel and HLW disposal. The staff still considers the Category 1 classification of this issue in the GEIS to be appropriate.

The staff has not identified any new and significant information during the staff's independent review of the Dresden ER (Exelon 2003a), the scoping process, the staff's site visit, the staff's evaluation of other available information, and public comments on the draft SEIS. Therefore, the staff concludes that there are no off-site radiological impacts related to spent fuel and HLW disposal during the renewal term beyond those discussed in the GEIS.

- Nonradiological impacts of the uranium fuel cycle. Based on information in the GEIS, the Commission found that

  > The nonradiological impacts of the uranium fuel cycle resulting from the renewal of an operating license for any plant are found to be small.

  The staff has not identified any new and significant information during the staff's independent review of the Dresden ER (Exelon 2003a), the scoping process, the staff's site visit, the staff's evaluation of other available information, and public comments on the draft SEIS. Therefore, the staff concludes that there are no nonradiological impacts of the uranium fuel cycle during the renewal term beyond those discussed in the GEIS.

- Low-level waste storage and disposal. Based on information in the GEIS, the Commission found that

  > The comprehensive regulatory controls that are in place and the low public doses being achieved at reactors ensure that the radiological impacts to the environment will remain small during the term of a renewed license. The maximum additional on-site land that may be required for low-level waste storage during the term of a renewed license and associated impacts will be small. Nonradiological impacts on air and water will be negligible. The radiological and nonradiological environmental impacts of long-term disposal of low-level waste from any individual plant at licensed

sites are small. In addition, the Commission concludes that there is reasonable assurance that sufficient low-level waste disposal capacity will be made available when needed for facilities to be decommissioned consistent with NRC decommissioning requirements.

The staff has not identified any new and significant information during the staff's independent review of the Dresden ER (Exelon 2003a), the scoping process, the staff's site visit, the staff's evaluation of other available information, and public comments on the draft SEIS. Therefore, the staff concludes that there are no impacts of low-level waste storage and disposal associated with the renewal term beyond those discussed in the GEIS.

- Mixed waste storage and disposal. Based on information in the GEIS, the Commission found that

  The comprehensive regulatory controls and the facilities and procedures that are in place ensure proper handling and storage, as well as negligible doses and exposure to toxic materials for the public and the environment at all plants. License renewal will not increase the small, continuing risk to human health and the environment posed by mixed waste at all plants. The radiological and nonradiological environmental impacts of long-term disposal of mixed waste from any individual plant at licensed sites are small. In addition, the Commission concludes that there is reasonable assurance that sufficient mixed waste disposal capacity will be made available when needed for facilities to be decommissioned consistent with NRC decommissioning requirements.

The staff has not identified any new and significant information during the staff's independent review of the Dresden ER (Exelon 2003a), the scoping process, the staff's site visit, the staff's evaluation of other available information, and public comments on the draft SEIS. Therefore, the staff concludes that there are no impacts of mixed waste storage and disposal associated with the renewal term beyond those discussed in the GEIS.

- On-site spent fuel. Based on information in the GEIS, the Commission found that

  The expected increase in the volume of spent fuel from an additional 20 years of operation can be safely accommodated on-site with small environmental effects through dry or pool storage at all plants if a permanent repository or monitored retrievable storage is not available.

The staff has not identified any new and significant information during the staff's independent review of the Dresden ER (Exelon 2003a), the scoping process, the staff's site visit, the staff's evaluation of other available information, and public comments on the draft SEIS. Therefore, the staff concludes that there are no impacts of on-site spent fuel associated with license renewal beyond those discussed in the GEIS.

- Nonradiological waste. Based on information in the GEIS, the Commission found that

  > No changes to generating systems are anticipated for license renewal. Facilities and procedures are in place to ensure continued proper handling and disposal at all plants.

  The staff has not identified any new and significant information during the staff's independent review of the Dresden ER (Exelon 2003a), the scoping process, the staff's site visit, the staff's evaluation of other available information, and public comments on the draft SEIS. Therefore, the staff concludes that there are no nonradiological waste impacts during the renewal term beyond those discussed in the GEIS.

- Transportation. Based on information in the GEIS, the Commission found that

  > The impacts of transporting spent fuel enriched up to 5 percent uranium-235 with average burnup for the peak rod to current levels approved by the NRC up to 62,000 megawatt-days per metric ton of uranium (MWd/MTU) and the cumulative impacts of transporting HLW to a single repository, such as Yucca Mountain, Nevada, are found to be consistent with the impact values contained in 10 CFR 51.52(c), Summary Table S-4, "Environmental Impact of Transportation of Fuel and Waste to and from One Light-Water-Cooled Nuclear Power Reactor." If fuel enrichment or burnup conditions are not met, the applicant must submit an assessment of the implications for the environmental impact values reported in Sec. 51.52.

  Dresden Units 2 and 3 meet the fuel enrichment and burn-up conditions set forth in Addendum 1 to the GEIS. The staff has not identified any new and significant information during the staff's independent review of the Dresden ER (Exelon 2003a), the scoping process, the staff's site visit, the staff's evaluation of other available information, and public comments on the draft SEIS. Therefore, the staff concludes that there are no impacts of transportation associated with license renewal beyond those discussed in the GEIS.

There are no Category 2 issues for the uranium fuel cycle and solid waste management.

6.2 References

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

10 CFR Part 54. Code of Federal Regulations, Title 10, *Energy,* Part 54, "Requirements for Renewal of Operating Licenses for Nuclear Power Plants."

10 CFR Part 63. Code of Federal Regulations, Title 10, *Energy,* Part 63, "Disposal of High-Level Radioactive Wastes in a Geologic Repository at Yucca Mountain, Nevada."

40 CFR Part 191. Code of Federal Regulations, Title 40, *Protection of Environment*, Part 191, "Environmental Radiation Protection Standards for Management and Disposal of Spent Nuclear Fuel, High-Level and Transuranic Radioactive Waste."

40 CFR Part 197. Code of Federal Regulations, Title 40, *Protection of Environment*, Part 197, "Public Health and Environmental Radiation Protection Standards for Management and Disposal for Yucca Mountain, Nevada."

66 FR 32132. "Public Health and Environmental Radiation Protection Standards for Yucca Mountain, NV." *Federal Register*. Vol. 66, No.114. June 13, 2001.

66 FR 55792. "Disposal of High-Level Radioactive Wastes in a Proposed Geologic Repository at Yucca Mountain, Nevada." *Federal Register*. Vol. 66, No. 213. November 2, 2001.

Energy Policy Act of 1992. 42 USC 10101, et seq.

Exelon Generation Company, LLC (Exelon). 2003. *Applicant's Environmental Report—Operating License Renewal Stage, Dresden Nuclear Power Station, Units 2 and 3*, Docket Nos. 50-237 and 50-249. Warrenville, Illinois. January 2003.

National Academy of Sciences (NAS). 1995. *Technical Bases for Yucca Mountain Standards*. Washington, D.C.

National Environmental Policy Act (NEPA) of 1969. 42 USC 4321, et seq.

U.S. Department of Energy (DOE). 1980. *Final Environmental Impact Statement: Management of Commercially Generated Radioactive Waste*. DOE/EIS-0046F. Washington, D.C.

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

U.S. Nuclear Regulatory Commission (NRC). 1999. *Generic Environmental Impact Statement for License Renewal of Nuclear Plants, Main Report*, "Section 6.3 – Transportation, Table 9.1, Summary of findings on NEPA issues for license renewal of nuclear power plants, Final Report." NUREG-1437, Volume 1, Addendum 1, Washington, D.C.

7.0 Environmental Impacts of Decommissioning

Environmental impacts from the activities associated with the decommissioning of any reactor before or at the end of an initial or renewed license are evaluated in the *Final Supplement 1 to the Generic Environmental Impact Statement for Decommissioning of Nuclear Facilities,* NUREG-0586 (NRC 2002). The staff's evaluation of the environmental impacts of decommissioning presented in Final Supplement 1 resulted in a range of impacts for each environmental issue. These results may be used by licensees as a starting point for a plant-specific evaluation of the decommissioning impacts at their facilities.

The incremental environmental impacts associated with decommissioning activities resulting, from continued plant operation during the renewal term, are evaluated in the *Generic Environmental Impact Statement for License Renewal of Nuclear Plants* (GEIS), NUREG-1437, Volumes 1 and 2 (NRC 1996, 1999) May 14, 2004.[(a)] The GEIS includes a determination of whether the analysis of the environmental issue could be applied to all plants and whether additional mitigation measures would be warranted. Issues are then assigned a Category 1 or a Category 2 designation. As set forth in the GEIS, Category 1 issues are those that meet all of the following criteria:

(1) The environmental impacts associated with the issue have been determined to apply either to all plants or, for some issues, to plants having a specific type of cooling system or other specified plant or site characteristic.

(2) A single significance level (i.e., SMALL, MODERATE, or LARGE) has been assigned to the impacts (except for collective off-site radiological impacts from the fuel cycle and from high-level waste and spent fuel disposal).

(3) Mitigation of adverse impacts associated with the issue has been considered in the analysis, and it has been determined that additional plant-specific mitigation measures are likely not to be sufficiently beneficial to warrant implementation.

For issues that meet the three Category 1 criteria, no additional plant-specific analysis is required unless new and significant information is identified.

Category 2 issues are those that do not meet one or more of the criteria for Category 1; and, therefore, additional plant-specific review of these issues is required. There are no Category 2 issues related to decommissioning.

(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.

7.1 Decommissioning

Category 1 issues in Table B-1 of 10 CFR Part 51, Subpart A, Appendix B, that are applicable to Dresden Units 2 and 3 decommissioning following the renewal term are listed in Table 7-1. Exelon Generation Company, LLC (Exelon) stated in its Environmental Report (ER) that it is aware of no new and significant information regarding the environmental impacts of Dresden Units 2 and 3 license renewal (Exelon 2003). The staff has not identified any new and significant information during the staff's independent review of the Dresden ER (Exelon 2003a), the scoping process, the staff's site visit, the staff's evaluation of other available information, and public comments on the draft SEIS. Therefore, the staff concludes that there are no impacts related to these issues beyond those discussed in the GEIS. For all of these issues, the staff concluded in the GEIS that the impacts are SMALL, and additional plant-specific mitigation measures are not likely to be sufficiently beneficial to be warranted.

Table 7-1. Category 1 Issues Applicable to the Decommissioning of Dresden Units 2 and 3 Following the Renewal Term

ISSUE—10 CFR PART 51, SUBPART A, APPENDIX B, TABLE B-1	GEIS Section
DECOMMISSIONING	
Radiation doses	7.3.1; 7.4
Waste management	7.3.2; 7.4
Air quality	7.3.3; 7.4
Water quality	7.3.4; 7.4
Ecological resources	7.3.5; 7.4
Socioeconomic impacts	7.3.7; 7.4

A brief description of the staff's review and the GEIS conclusions, as codified in Table B-1, for each of the issues follows:

- Radiation doses. Based on information in the GEIS, the Commission found that

  > Doses to the public will be well below applicable regulatory standards regardless of which decommissioning method is used. Occupational doses would increase no more than 1 man-rem (0.01 person-Sv) caused by buildup of long-lived radionuclides during the license renewal term.

  The staff has not identified any new and significant information during the staff's independent review of the Dresden ER (Exelon 2003a), the scoping process, the staff's site visit, the staff's evaluation of other available information, and public comments on the draft SEIS. Therefore, the staff concludes that there are no radiation doses associated with decommissioning following license renewal beyond those discussed in the GEIS.

- Waste management. Based on information in the GEIS, the Commission found that

  > Decommissioning at the end of a 20-year license renewal period would generate no more solid wastes than at the end of the current license term. No increase in the quantities of Class C or greater than Class C wastes would be expected.

  The staff has not identified any new and significant information during the staff's independent review of the Dresden ER (Exelon 2003a), the scoping process, the staff's site visit, the staff's evaluation of other available information, and public comments on the draft SEIS. Therefore, the staff concludes that there are no impacts of solid waste associated with decommissioning following the license renewal term beyond those discussed in the GEIS.

- Air quality. Based on information in the GEIS, the Commission found that

  > Air-quality impacts of decommissioning are expected to be negligible either at the end of the current operating term or at the end of the license renewal term.

  The staff has not identified any new and significant information during the staff's independent review of the Dresden ER (Exelon 2003a), the scoping process, the staff's site visit, the staff's evaluation of other available information, and public comments on the draft SEIS. Therefore, the staff concludes that there are no impacts of license renewal on air quality during decommissioning beyond those discussed in the GEIS.

- Water quality. Based on information in the GEIS, the Commission found that

  > The potential for significant water-quality impacts from erosion or spills is no greater whether decommissioning occurs after a 20-year license renewal period or after the original 40-year operation period, and measures are readily available to avoid such impacts.

  The staff has not identified any new and significant information during the staff's independent review of the Dresden ER (Exelon 2003a), the scoping process, the staff's site visit, the staff's evaluation of other available information, and public comments on the draft SEIS. Therefore, the staff concludes that there are no impacts of the license renewal term on water quality during decommissioning beyond those discussed in the GEIS.

- Ecological resources. Based on information in the GEIS, the Commission found that

  > Decommissioning after either the initial operating period or after a 20-year license renewal period is not expected to have any direct ecological impacts.

  The staff has not identified any new and significant information during the staff's independent review of the Dresden ER (Exelon 2003a), the scoping process, the staff's site visit, the staff's evaluation of other available information, and public comments on

the draft SEIS. Therefore, the staff concludes that there are no impacts of the license renewal term on ecological resources during decommissioning beyond those discussed in the GEIS.

- Socioeconomic Impacts. Based on information in the GEIS, the Commission found that

  > Decommissioning would have some short-term socioeconomic impacts. The impacts would not be increased by delaying decommissioning until the end of a 20-year relicense period, but they might be decreased by population and economic growth.

The staff has not identified any new and significant information during the staff's independent review of the Dresden ER (Exelon 2003a), the scoping process, the staff's site visit, the staff's evaluation of other available information, and public comments on the draft SEIS. Therefore, the staff concludes that there are no impacts of license renewal on the socioeconomic impacts of decommissioning beyond those discussed in the GEIS.

7.2 References

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

Exelon Generation Company, LLC (Exelon). 2003. *Applicant's Environmental Report – Operating License Renewal Stage, Dresden Nuclear Power Station, Units 2 and 3.* Docket Nos. 50-237 and 50-249. Warrenville, Illinois. January 2003.

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

U.S. Nuclear Regulatory Commission (NRC). 1999. *Generic Environmental Impact Statement for License Renewal of Nuclear Plants, Main Report*, "Section 6.3 – Transportation, Table 9.1, Summary of findings on NEPA issues for license renewal of nuclear power plants, Final Report." NUREG-1437, Volume 1, Addendum 1, Washington, D.C.

U.S. Nuclear Regulatory Commission (NRC). 2002. *Generic Environmental Impact Statement on Decommissioning of Nuclear Facilities, Supplement 1 Regarding the Decommissioning of Nuclear Power Reactors*. NUREG-0586, Vol. 1 and 2, Washington, D.C.

8.0 Environmental Impacts of Alternatives to Operating License Renewal

This chapter examines the potential environmental impacts associated with denying the renewal of the operating licenses (OLs) (i.e., the no-action alternative) for Dresden Units 2 and 3; the potential environmental impacts from electric generating sources other than Dresden Units 2 and 3; the possibility of purchasing electric power from other sources to replace power generated by Dresden Units 2 and 3 and the associated environmental impacts; the potential environmental impacts from a combination of generating and conservation measures; and other generation alternatives that were deemed unsuitable for replacement of power generated by Dresden Units 2 and 3. The environmental impacts are evaluated using the U.S. Nuclear Regulatory Commission's (NRC's) three-level standard of significance — SMALL, MODERATE, or LARGE — that were developed using the Council on Environmental Quality guidelines and set forth in a footnote to Table B-1 of 10 CFR Part 51, Subpart A, Appendix B:

> SMALL — Environmental effects are not detectable or are so minor that they will neither destabilize nor noticeably alter any important attribute of the resource.
>
> MODERATE — Environmental effects are sufficient to alter noticeably, but not to destabilize important attributes of the resource.
>
> LARGE — Environmental effects are clearly noticeable and are sufficient to destabilize important attributes of the resource.

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

8.1 No-Action Alternative

The NRC's regulations implementing the National Environmental Policy Act (NEPA) specify that the no-action alternative be discussed in a NRC environmental impact statement (EIS) (10 CFR Part 51, Subpart A, Appendix A4). For license renewal, the no-action alternative refers to a scenario in which the NRC would not renew the OLs for Dresden Units 2 and 3; and Exelon Generation Company, LLC (Exelon) would then decommission Dresden Units 2 and 3 when plant operations cease.

(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.

The no-action alternative is a conceptual alternative resulting in a net reduction in electricity generation; there would be no replacement power and, therefore, no environmental impacts from replacement power. In actual practice, the power lost by not renewing the OLs for Dresden Units 2 and 3 would likely be replaced by (1) demand-side management (DSM) and energy conservation, (2) electricity generated from other sources, either by Exelon or by another generator, or (3) some combination of these alternatives. Any replacement power would produce environmental impacts in addition to those discussed under the no-action alternative. Environmental impacts of these other sources are discussed in this section.

Exelon will be required to comply with the NRC decommissioning requirements whether or not the OLs are renewed and, therefore, must comply under the no-action alternative. If the OLs for Dresden Units 2 and 3 are renewed, decommissioning activities could be postponed for up to an additional 20 years. If the OLs are not renewed, Exelon 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 bound by the discussion of impacts in Chapter 7 of the GEIS (NRC 1996), Chapter 7 of this supplemental environmental impact statement (SEIS); the *Final Generic Environmental Impact Statement on Decommissioning of Nuclear Facilities,* NUREG-0586, dated August 1988; and the supplement to the decommissioning GEIS (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 associated with the no-action alternative are summarized in Table 8-1. Implementation of the no-action alternative would also have certain positive impacts in that adverse environmental impacts associated with the current operation of Dresden Units 2 and 3 (for example, any adverse ecological impacts) would be eliminated or reduced.

- **Land Use**

  Temporary changes in on-site land use for portions of the site could occur during decommissioning. Temporary changes may include the addition or the expansion of staging and laydown areas or construction of temporary buildings and parking areas. No off-site land-use changes are expected as a result of decommissioning. 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	Impacts expected to be temporary.
Ecology	SMALL	Impacts on ecology would be expected to be temporary and largely mitigated by using best management practices.
Water Use and Quality	SMALL	Water use would decrease. Water quality is unlikely to be adversely affected.
Air Quality	SMALL	Greatest impact would likely be from fugitive dust; impact could be mitigated by good management practices.
Waste	SMALL	Low-level radioactive waste would 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 would be expected to be within regulatory limit and comparable to, or lower than, doses from other operating plants. Occupational injuries would be possible, but injury rates at nuclear power plants are below the U.S. average industrial rate.
Socioeconomics	LARGE	Impacts on employment mitigated due to proximity to Chicago metropolitan area. Impacts on tax revenue of Grundy County.
Aesthetics	SMALL	Positive impact from eventual removal of buildings and structures. Some noise impact during decommissioning operations.
Historic and Archaeological Resources	SMALL	Impacts primarily confined to land utilized during plant operations.
Environmental Justice	SMALL	Impacts on minority and low-income communities would be similar to those experienced by the population as a whole.

- **Ecology**

  Impacts on aquatic ecology at the Dresden site could result from removal of in-water pipes and structures or the filling of the intake and discharge canals. 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. However, land disturbance is expected to be minimal and would result in relatively short-term impacts that could be mitigated using best management practices. The land is expected to recover naturally. The impacts of the no-action alternative on ecology are considered SMALL.

- **Water Use and Quality**

  Cessation of plant operations would result in a beneficial reduction in water use because reactor cooling will no longer be required. As the number of plant staff is reduced, the demand for potable water is expected to decrease also. Water quality is unlikely to be adversely affected. Overall, the impacts of the no-action alternative on water use and quality 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, the impacts of the no-action alternative on air quality 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 waste treatment and volume reduction procedures used. Low-level radioactive waste must be disposed of in a facility licensed by the NRC or a State with authority delegated by the NRC. Recent advances in volume reduction and waste processing have significantly reduced waste volumes.

A permanent repository for high-level waste (HLV) 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 on-site or off-site independent spent fuel storage installations (10 CFR 51.23[a]). Overall, the impacts of the no-action alternative on waste 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 other operating nuclear power plants (NRC 2002). 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, but injury rates at nuclear plants are below the U.S. average industrial rate. Overall, the impacts of the no-action alternative on human health are considered SMALL.

- **Socioeconomics**

If Dresden Units 2 and 3 cease operation, there would be a decrease in employment and tax revenues associated with the closure. These impacts would be most concentrated in Grundy and Will counties with smaller impacts in adjoining counties. There would be some adverse impacts on local housing values and the local economy in Grundy and Will counties, and other adjoining counties to a lesser extent, under the no-action alternative.

Tax revenue losses as a result of the closure of Dresden Units 2 and 3 would occur in Grundy and Will counties. For the years 1997 through 2000, property taxes from Dresden Units 2 and 3 provided between 13 and 20 percent of Grundy County's total levee extension and between 13 and 21 percent of Grundy County's total collections available for distribution (Exelon 2003). For the years 1997 through 2000, property taxes from Dresden Units 2 and 3 provided less than 1 percent of Will County's total levee extension and less than 1 percent of Will County's total collections available for distribution (Exelon 2003). Hence, nonrenewal of the operating license for Dresden Units 2 and 3 could have significant impacts on the tax base of Grundy County but not of Will County. However, because of changes in the regulation of the electricity sector in Illinois, tax payments will go down in

Grundy County by some portion even under license renewal although likely significantly less than under the no-action alternative.

The no-action alternative would result in the loss of plant payrolls 20 years earlier than if the OLs were renewed. Dresden Units 2 and 3 currently support approximately 870 permanent employees and approximately 120 to 130 contract workers (Exelon 2003). Because approximately 72 percent of employees who work at the Dresden site live in Grundy and Will counties (Exelon 2003), primary employment impacts would be concentrated in these counties. However, the proximity to the Chicago metropolitan area would mitigate much of the employment impact. Most secondary employment impacts and impacts on population would also be concentrated in Grundy and Will counties. Exelon employees working at the Dresden site currently contribute time and money toward community involvement, including schools, churches, charities, and other civic activities. It is likely that with a reduced presence in the community following decommissioning, Exelon's community involvement efforts in the region would be lessened.

Overall, the no-action alternative would have a LARGE socioeconomic impact because of the importance of the tax revenue from Dresden Units 2 and 3 to Grundy County.

- **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 may be detectable off-site; however, the impact is unlikely to be of significance, and noise would cease altogether following decommissioning. Overall, the impacts of the no-action alternative on aesthetics are considered SMALL.

- **Historic and Archaeological Resources**

The potential for future adverse impacts to known or unrecorded cultural resources at the Dresden site following decommissioning would depend on the future use of the site land and on an analysis and determinations of the historic status of the plant, including the units for decommissioning. There is one known archaeological site on Dresden site proper. This site was examined in 1973 by a professional archaeologist, Dr. Robert Hall of the University of Illinois, who determined that disturbance caused by construction was minimal (Exelon 2003).

According to the applicant, decommissioning of Dresden Unit 1 will occur simultaneously with the decommissioning of Dresden Units 2 and 3 (Exelon 2003). A no-action decision could initiate decommissioning activities within the next eight years as license expiration approaches for Units 2 and 3. Dresden Unit 1, listed as an American Nuclear Society Nuclear Historic Landmark, will be over 50 years of age and is likely to meet the eligibility criteria for listing on the National Register of Historic Places (NRHP). An evaluation of historical significance of Dresden Unit 1, pursuant to the National Historic Preservation Act, would be required prior to activities that could adversely affect the property, i.e., decommissioning, dismantling, or modifying the facility/reactor. Should Dresden Unit 1 be determined eligible for the NRHP, its decommissioning would constitute an adverse effect. Development and implementation of a mitigation plan, in consultation with the Illinois State Historic Preservation Office (SHPO), would be required. Overall, the impacts of the no-action alternative on historic and archaeological resources are considered SMALL.

- **Environmental Justice**

Current operations at the Dresden site have no disproportionate impacts on the minority and low-income populations of the surrounding counties, and no environmental pathways have been identified that would cause disproportionate impacts. Closure of Dresden Units 2 and 3 would result in decreased employment opportunities and reduced tax revenues in Grundy County with possible small negative and disproportionate impacts on minority or low-income populations. Because the Dresden site is located in the economically vital Chicago metropolitan area with extensive employment opportunities, these effects are likely to be offset. The impacts of closure on minority and low-income populations would be offset by other local employment opportunities. Overall, the impacts of the no-action alternative on minority or low-income populations are considered SMALL.

8.2 Alternative Energy Sources

This section discusses the environmental impacts associated with alternative sources of electricity to replace the electricity generated by Dresden Units 2 and 3, assuming that the OLs for Dresden Units 2 and 3 are not renewed. According to Exelon, the capacity of Dresden Units 2 and 3 is approximately 1824 MW(e), based on the two units each having a capacity of 912 MW(e) (Exelon 2003). The Energy Information Administration (EIA), a component of the U.S. Department of Energy (DOE), estimates the peak summer capacity of Dresden Units 2 and 3 as 1568 MW(e) (DOE/EIA 2003b). For the remainder of this section, the staff considered the total capacity of Dresden Units 2 and 3 to be 1824 MW(e).

The order of presentation of alternative energy sources in Section 8.2 does not imply which alternative would be most likely to occur or to have the least environmental impacts. The following generation alternatives are considered in detail:

- Coal-fired generation at the Dresden site and at an alternate site (Section 8.2.1)
- Natural gas-fired generation at the Dresden site and at an alternate site (Section 8.2.2)
- Nuclear generation at the Dresden site and at an alternate site (Section 8.2.3).

The alternative of purchasing power from other sources to replace power generated at Dresden Units 2 and 3 is discussed in Section 8.2.4. Other power-generation alternatives and conservation alternatives considered by the staff and found to be unreasonable replacements for Dresden Units 2 and 3 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) issues an Annual Energy Outlook. The *Annual Energy Outlook 2002 with Projections to 2020* was issued in December 2001 (DOE/EIA 2001a). In this report, EIA projected that combined-cycle[(a)] or combustion turbine technology fueled by natural gas is likely to account for approximately 88 percent of new electric generating capacity through the year 2020 (DOE/EIA 2001a). Both technologies are designed primarily to supply peak and intermediate capacity, but combined-cycle technology can also be used to meet baseload[(b)] requirements. Coal-fired plants were 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, were projected by EIA to account for the remaining 3 percent of capacity additions. EIA projected that oil-fired plants will account for very little new generation capacity in the United States through the year 2020 because of higher fuel costs and lower efficiencies (DOE/EIA 2001a). EIA's projections were based on the assumption that providers of new generating capacity will seek to minimize cost while meeting applicable environmental requirements. Combined-cycle plants were projected by EIA to have the lowest

(a) In the 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.
(b) 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; that is, these units generally run near full load.

generation cost in 2005 and 2020, followed by coal-fired plants, and then by wind generation (DOE/EIA 2001a).

EIA also projected that new nuclear power plants will not account for any new generation capacity in the United States through the year 2020 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 Dresden Units 2 and 3 is considered for reasons stated in Section 8.2.3. Since 1997, the NRC has certified three new standard designs for nuclear power plants under the procedures in 10 CFR Part 52, Subpart B. The submission to the NRC of these three applications for certification indicates continuing interest in the possibility of licensing new nuclear power plants. The NRC has established a new organization to prepare for and manage future reactor and site licensing applications.

Note that this section discusses the impacts of alternative generation technologies. It does not address the impacts of decommissioning. Further, it does not consider the impacts to the Dresden site of building alternate generation elsewhere, when such options are addressed. The no-action alternative, discussed in Section 8.1, covers the impacts at the Dresden site of shutting down Dresden Units 2 and 3.

8.2.1 Coal-Fired Generation

The environmental impacts of the coal-fired alternative are examined in this section for the Dresden site and at an alternate site. Unless otherwise indicated, the assumptions and numerical values used in this section are from the Exelon Environmental Report (ER) (Exelon 2003). The staff reviewed this information and compared it to environmental impact information in the GEIS, as well as other relevant information and sources where appropriate. 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). The staff assumed that Dresden Units 2 and 3 would remain in operation while the coal-fired alternative was constructed.

The coal-fired alternative is analyzed both for the existing Dresden site and for an unnamed alternate site. Siting a new coal-fired plant where an existing nuclear plant is located would reduce many construction impacts (NRC 1996). Further, siting a new facility at the existing Dresden site would allow it to take advantage of existing infrastructure. Hence, although the staff considered an alternate site, it is unlikely that it would be beneficial to place a new coal-fired facility at an alternate site based purely on environmental grounds.

The staff assumes the construction of three 550-MW(e) units for a combined capacity of 1650 MW(e), as potential replacements for Dresden Units 2 and 3, which is consistent with Exelon's ER (Exelon 2003).[a] Exelon chose this size to be consistent with the natural gas-fired alternative, which was chosen to match "standard" sizes for new combined-cycle facilities. The assumption of 1650 MW(e) understates the environmental impacts of replacing the 1824 MW(e) from Dresden Units 2 and 3. The remaining capacity would be made up from other sources. As a rough estimate, if a coal-fired plant of exactly 1824 MW(e) were to be built, any impacts (e.g., pollutant emissions) in this section might simply be adjusted upwards accordingly. However, given these adjustments, the staff has determined that the differences in impacts between 1650 MW(e) and 1824 MW(e) of coal-fired generation would not be significant and would not change the impact levels.

Exelon assumes the coal-fired plant would use tangentially fired, dry-bottom combustors with an associated heat rate [b] of 10,200 Btu/kWh (a thermodynamic efficiency of approximately 30 percent) and a capacity factor [c] of 0.85 (Exelon 2003). According to Exelon, the coal-fired plant would consume approximately 6.3 million MT (6.9 million tons) per year of pulverized bituminous coal with an ash content of approximately 6.9 percent (Exelon 2003). For emissions control, the facility would be outfitted with low nitrogen oxide (NO_x) burners, overfire air and selective catalytic reduction for NO_x control; fabric filters for control of particulates; and a wet scrubber using lime for the control of sulfur oxides (SO_x).

The coal-fired alternative would require converting a significant quantity of land to industrial use for the power plant, coal storage, landfill disposal of ash, spent catalytic reduction catalyst (used for control of NO_x emissions), and scrubber sludge. The Dresden site is adequate to support these requirements. The Dresden site consists of approximately 1012 ha (2500 ac) owned by Exelon and 7 ha (17 ac) of river frontage leased from the State of Illinois (Exelon 2003). The GEIS asserts that approximately 700 ha (1700 ac) would be required to build a 1000-MW(e), coal-fired power plant at a greenfield site (NRC 1996). Locating a coal-fired power plant at an existing nuclear site would significantly lower this land requirement and would allow the new facility to take advantage of existing infrastructure at the Dresden site, including the existing cooling system, switchyard, offices, intake and discharge, and transmission rights-of-way. Exelon estimates that the coal-fired alternative would require approximately 75 ha (180 ac) for

(a) The coal-fired units would have a rating of 583 gross MW(e) and 550 net MW(e). The difference between "gross" and "net" is the electricity consumed on-site.
(b) Heat rate is a measure of generating station thermal efficiency. It is generally expressed in British thermal units (Btu) per net kilowatt-hour (kWh). It is computed by dividing the total Btu content of fuel burned for electricity-generation by the resulting net kWh generation.
(c) The capacity factor is the ratio of electricity generated for the period of time considered to the energy that could have been generated at continuous full-power operation during the same period.

waste disposal and approximately 120 ha (300 ac) for the power block and coal storage area. Even if the actual requirement were well above this level of approximately 195 ha (480 ac), the existing Dresden site should be able to support a new coal-fired facility.

Two coal and lime delivery options are most appropriate for the Dresden site: barge and rail. The Dresden site location lends itself to coal delivery by barge, which is a common practice along the Illinois waterway. The coal-fired alternative would require construction of a barge offloading facility on the Dresden Pool and a conveyor system to the Dresden coal yard. These new facilities would result in greater construction impacts than upgrading the existing rail line (Exelon 2003). The alternative would trade barge traffic impacts for rail traffic impacts. The staff agrees with Exelon that such a trade-off provides no obvious environmental benefit, and the barge alternative is considered in this section. A coal slurry pipeline is another potential alternative for delivering coal. However, such a pipeline would need to cover a great distance to reach a suitable coal mining area or the coal would need to be transported by alternate means (e.g., rail) to a site closer to the Dresden site for introduction into the pipeline. The coal slurry pipeline alternative for delivering coal is not further evaluated.

8.2.1.1 Closed-Cycle Cooling System

For purposes of this SEIS, the staff assumed a coal-fired plant at the Dresden site would use the existing modified, closed-cycle cooling system. The system uses a large cooling pond to cool water either for reuse (closed-cycle) or for discharge into the Illinois River (indirect open-cycle). The system is currently run in closed-cycle for approximately one-half of the year and in indirect open-cycle for the other half (Exelon 2003). Recently, Exelon has added cooling towers to eliminate the need to derate Dresden in summer months when thermal discharges into the Illinois River are too high. A true open-cycle system would not significantly cool the water before discharge into the Illinois River or other water body. Hence, the staff concluded that the current operating procedure would constitute the closed-cycle option. At an alternate site, the staff assumed that the coal-fired alternative would also use a closed-cycle cooling system with cooling towers.

The overall impacts of the coal-fired generating system using a closed-cycle cooling system are discussed in the following sections and summarized in Table 8-2. For completeness, the staff also considered the impacts of a fully open-cycle cooling system with no cooling pond at an alternate site. Additional impacts from the use of an open-cycle cooling system are considered in Section 8.2.1.2.

Table 8-2. Summary of Environmental Impacts of Coal-Fired Generation at the Dresden Site and an Alternate Site Using a Closed-Cycle Cooling System

	Dresden Site		Alternate Site	
Impact Category	**Impact**	**Comments**	**Impact**	**Comments**
Land Use	MODERATE	Would use unused portion of Dresden site. Would require approximately 195 ha (480 ac) for power block, coal storage, and waste disposal. Would use any existing infrastructure (e.g., transmission lines). Additional land impacts for coal and limestone mining.	MODERATE to LARGE	Potentially 700 ha (1700 ac) for new coal facility, including power block, infrastructure, coal storage, and waste disposal. Additional land impacts for coal and limestone mining. Total impact would depend on whether the alternate site is previously disturbed.
Ecology	MODERATE	Would use undeveloped areas at Dresden site. There would be potential for habitat loss and fragmentation and reduced productivity and biological diversity.	MODERATE to LARGE	Impact would depend on location and ecological conditions of site and transmission line route. There would be potential for habitat loss and fragmentation and reduced productivity and biological diversity.
Water Use and Quality	SMALL	Would use existing modified closed-cycle cooling system and continue current very limited groundwater use.	SMALL to MODERATE	Impact would depend on volume of water withdrawal, the constituents of the discharge water, and the characteristics of surface-water body or groundwater source.

Table 8-2. (contd)

	Dresden Site		Alternate Site	
Impact Category	**Impact**	**Comments**	**Impact**	**Comments**
Air Quality	MODERATE	Sulfur oxides: 6000 MT/yr (6600 tons/yr) — Actual impact would depend on emissions allowances. Nitrogen oxides: 1561 MT/yr (1721 tons/yr) — Actual impact would depend on emissions offsets Particulates: 216 MT/yr (238 tons/yr) particulates, 50 MT/yr (55 tons/yr) PM_{10} Carbon monoxide: 1561 MT/yr (1721 tons/yr) Other: Some hazardous air pollutants, CO_2 emissions contribute to global warming	MODERATE	Same emissions as Dresden site, although allowances for SO_2 and offsets for NO_x would depend on location.
Waste	MODERATE	Total ash production would be 431,000 MT (475,000 tons) annually, but 87 percent of this ash would be recycled. Facility would also generate 311,000 MT (343,000 tons) of scrubber sludge annually.	MODERATE	Same impacts as Dresden site.

Table 8-2. (contd)

	Dresden Site		Alternate Site	
Impact Category	**Impact**	**Comments**	**Impact**	**Comments**
Human Health	SMALL	Impacts are uncertain, but are considered SMALL in the absence of more quantitative data.	SMALL	Same impacts as for Dresden site.
Socioeconomics	SMALL to MODERATE	During construction, impacts would be SMALL to MODERATE. Upwards of 2500 workers might be required at peak of the 5-year construction period.	SMALL to LARGE	Construction impacts at alternate site would be similar to those at Dresden site, but would depend on whether new site is located near a major metropolitan area.
		During operation, employment would be decreased from approximately 1000 permanent and contract to closer to 250. All employment impacts would be tempered by proximity to Chicago metropolitan area. New tax base would offset loss of current tax base.		Grundy County would lose significant portion of tax base.
		Transportation impacts during operation would be SMALL due to the smaller workforce. Transportation impacts associated with construction workers would be MODERATE.		Transportation impacts would be similar to those at Dresden site.

Table 8-2. (contd)

	Dresden Site		Alternate Site	
Impact Category	**Impact**	**Comments**	**Impact**	**Comments**
Aesthetics	MODERATE	MODERATE aesthetic impact due to impact of plant buildings and structures, along with noise impacts from plant operation.	MODERATE to LARGE	Impacts would similar to those at Dresden site, but would also include any aesthetic impacts from building new transmission line(s). Impacts would depend on location.
Historic and Archaeological Resources	SMALL to MODERATE	Studies would likely be needed to identify, evaluate, and address mitigation of the potential impacts of new plant construction on cultural resources at developed and undeveloped sites.	SMALL to MODERATE	Alternate location would necessitate cultural studies. Studies would likely be needed to identify, evaluate, and address mitigation of the potential impacts of new plant construction on cultural resources at developed and undeveloped sites
Environmental Justice	SMALL	No environmental pathways or locations have been identified that would result in disproportionately high and adverse environmental impacts on minority and low-income populations. Impacts on minority and low-income communities should be similar to those experienced by the population as a whole.	SMALL to LARGE	Impacts vary depending on population distribution and characteristics at new site. Impacts on Dresden site would be identical to those in the no-action alternative.

- **Land Use**

  For siting a new facility at the Dresden site, the existing infrastructure would be used to the extent practicable, thus limiting the amount of new construction that would be required. Specifically, the staff assumed that the new coal-fired facility would use the existing cooling system, switchyard, offices, and transmission rights-of-way. If the coal-fired facility is built at the existing Dresden site, Exelon estimates that construction of the power block and coal storage area would impact approximately 120 ha (300 ac) of land and associated terrestrial habitat (Exelon 2003). Exelon further estimates that ash and scrubber waste disposal over a 40-year facility lifetime would require approximately 75 ha (180 ac) (Exelon 2003). In total, the facility is expected to require approximately 195 ha (480 ac) of land. The GEIS estimates on the order of 690 ha (1700 ac) for a greenfield, 1000-MW(e), coal-fired power plant, well above the estimates from Exelon for the 1650-MW(e) power plant. A portion of this difference may be due to the potential use of existing infrastructure at the Dresden site.

  The coal-fired alternative at the Dresden site would require construction of a barge offloading facility on the Dresden Pool and a conveyor system to the Dresden coal yard requiring the conversion of river-front land to industrial use.

  For an alternate greenfield site, the land use will be above the 700 ha (1700 ac) assumed in the GEIS for a new 1000-MW(e), coal-fired power plant, assuming scaling of the GEIS estimates. A new site would require land for the power block, for coal storage and handling, and for waste products. Additional land could be required for a transmission line and for a rail spur to the plant site, depending on the infrastructure in existence at the alternate site.

  Regardless of whether the coal-fired plant is built at the Dresden or at an alternate site, additional land-use changes would occur off-site 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-fired plant during its operational life (NRC 1996). Partially offsetting this off-site land use would be the elimination of the need for uranium mining to supply fuel for Dresden Units 2 and 3. In the GEIS, the staff estimated that approximately 400 ha (1000 ac) would be affected for mining the uranium and processing it during the operating life of a 1000-MW(e) nuclear power plant.

  Overall, the impacts of the coal-fired plant at the Dresden site are considered MODERATE. Previously unused land would need to be converted to industrial use. Overall, the impacts of the coal-fired plant at an alternate site are considered MODERATE to LARGE, depending on whether the alternate site had been developed previously or not and what new infrastructure might be required.

- **Ecology**

  Locating a coal-fired plant at the Dresden site could affect ecological resources because of the need to convert approximately 195 ha (480 ac) of currently unused land to industrial use for the plant, coal storage, and ash and scrubber sludge disposal. Impacts to zoological resources could include habitat degradation, fragmentation, habitat loss, reduced ecosystem productivity, and a reduction in biological diversity. Impacts to terrestrial ecology would be somewhat reduced because some of the area to be developed would be land previously disturbed by site activities and, thus, of less ecological value. Use of cooling towers would reduce operational impacts on the aquatic ecosystem. Overall, the impacts of the coal-fired alternative at the Dresden site are considered MODERATE.

  At an alternate site, the construction and operation of a coal-fired plant would result in some ecological impacts. As with the existing site, impacts to ecological resources could include habitat degradation, fragmentation, habitat loss, reduced ecosystem productivity, and a reduction in biological diversity. Construction and maintenance of transmission line(s) and a rail spur also would have ecological impacts. Use of make-up cooling water from a nearby surface-water body could have adverse aquatic resource impacts. Overall, the impacts of the coal-fired alternative at an alternate site are considered MODERATE to LARGE, depending on the ecological conditions on the site.

- **Water Use and Quality**

  The coal-fired alternative at the existing site would use the existing modified, closed-cycle cooling system and would, therefore, have no incremental impacts on cooling water needs. Some erosion and sedimentation probably would occur during construction (NRC 1996). The three groundwater wells that supply limited specific uses at the Dresden site would continue to be used. Overall, the impacts of the coal-fired alternative at the Dresden site are considered SMALL.

  At an alternate site, the cooling water would likely be drawn from a surface body of water. The impact would depend on the volume of water withdrawn, the constituents of the water, and the characteristics of the surface water body or groundwater source. Plant discharges would consist mostly of cooling tower blowdown, characterized primarily by an increased temperature and increased concentration of dissolved solids relative to the receiving body of water and intermittent low concentrations of biocides (e.g., chlorine). Treated process waste streams and sanitary wastewater would also be discharged. All discharges would likely be regulated through a National Pollution Discharge Elimination System (NPDES) permit. Use of groundwater for a coal-fired plant at an alternate site is a possibility. There

would be consumptive use of water due to evaporation from the cooling towers. Some erosion and sedimentation probably would occur during construction (NRC 1996). Overall, the impacts at an alternate site are considered SMALL to MODERATE.

- **Air Quality**

  The air quality impacts of coal-fired generation are significantly higher than those of nuclear generation due to emissions of SO_x, NO_x, particulates, carbon monoxide, hazardous air pollutants, such as mercury, and naturally occurring radioactive materials.

  The Dresden site is located in the Metropolitan Chicago Interstate Air Quality Control Region (40 CFR 81.75). This region is designated as in attainment or unclassified for all criteria pollutants with the exception of ozone[a] (40 CFR 81.314). Goose Lake Township, where the Dresden site is located, is in nonattainment for ozone.

  A new coal-fired generating plant located at the Dresden site would likely need a prevention of significant deterioration (PSD) permit and an operating permit under the Clean Air Act. The plant would need to comply with the new source performance standards for such plants set forth in 40 CFR Part 60, Subpart Da, which consists of 40 CFR Part 60.40a through 40 CFR Part 60.49a. Standards establish limits for particulate matter and opacity (40 CFR 60.42a), sulfur dioxide (40 CFR 60.43a), and NO_x (40 CFR 60.44a).

  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 man-made air pollution. In addition, EPA issued a new regional haze rule in 1999 (64 FR 35714). 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 new coal-fired power station were located close to a mandatory class I Federal area, additional air pollution control requirements could be imposed. However, there are no mandatory class I Federal areas near the Dresden site. It is assumed that an alternate site would not be chosen near a mandatory class I Federal area.

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

The U.S. Environmental Protection Agency (EPA) has various regulatory requirements for visibility protection in 40 CFR Part 51, Subpart P, including a specific requirement for review of any new major stationary source in an area designated as attainment or unclassified under the Clean Air Act. As noted above, the Dresden site is in a region that is either attainment or unclassified for all criteria pollutants with the exception of ozone.

Impacts and issues for particular pollutants are below. (Unless otherwise stated, the impacts for particular pollutants would be the same at the Dresden site or at an alternate site.)

- Sulfur oxides. 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 sulfur dioxide 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 sulfur dioxide emissions and imposes controls on sulfur dioxide emissions through a system of marketable allowances. EPA issues one allowance for each ton of sulfur dioxide that a unit is allowed to emit. New units do not receive allowances but are required to have allowances to cover their sulfur dioxide emissions. Owners of new units must, therefore, acquire allowances from owners of other power plants by purchase or by reducing sulfur dioxide emissions at other power plants that they own. Allowances can be banked for use in future years. Because Exelon has no fossil-fired power plants (Exelon 2003), it would need to purchase allowances from the open market to operate a coal-fired power plant at the Dresden site. Whether the coal-fired alternative results in an aggregate increase in sulfur dioxide emissions would depend on whether the permits are purchased when there is a surplus of permits or when the market is constrained. In the latter case, the coal-fired alternative would result in no net increase in aggregate national sulfur dioxide emissions. Regardless, however, the coal-fired power plant would result in a local increase in sulfur dioxide emissions whether located at the Dresden site or an alternate site.

  Exelon states in its ER that the alternative coal-fired power plant would minimize air emissions through a combination of boiler technology and post-combustion pollution removal. Sulfur dioxide would be removed using lime in a flue gas desulfurization process (Exelon 2003). Exelon estimates that by using a wet scrubber control technology, 95 percent of the stack emissions of sulfur dioxide could be collected, so that total emissions, after scrubbing, would be approximately 6000 MT per year (6600 tons/yr) of sulfur dioxide (Exelon 2003).

- Nitrogen oxides and volatile organic compounds. Ground-level ozone is a primary concern of the EPA. Ground level ozone is formed when oxides of nitrogen (NO_x) and volatile organic compounds (VOCs) react in the presence of sunlight. Ozone precursors such as these, and ozone itself, can be carried hundreds of miles from their source, potentially causing pollution over wide regions.

  In 1998, the EPA promulgated a rule requiring 21 states, including Illinois, to reduce NO_x emissions (63 FR 57356). The rule specifies total NO_x emissions (40 CFR 51.121e) for each State but leaves open the method of implementation. The emissions reduction measures are to be in place by May 31, 2004. In its State Implementation Plan (SIP), Illinois has chosen to implement a market-based emissions credit trading system for NO_x. According to the system, NO_x emissions from large electricity generating units may not exceed 27,851 MT (30,701 tons) during each ozone season. A small percentage of NO_x credits was set aside for new sources (Exelon 2003). New NO_x emissions will, therefore, depend both on how many new credits are available and whether any purchases of credits are made in a constrained market. In the most extreme case, all of the credits would need to be purchased on the open market, and such purchases would result in reductions from sources elsewhere. Even in this case, however, NO_x emissions could simply move out of state. The staff assumed that, even if the coal-fired alternative were located at an alternate site, the alternate site would be in Illinois and, therefore, subject to the allowance system.

  Section 407 of the Clean Air Act establishes technology-based emission limitations for NO_x emissions. The market-based allowance system used for sulfur dioxide 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_x) in excess of 200 nanograms per joule (ng/J) of gross energy output (1.6 lb/MWh), based on a 30-day rolling average.

  The Dresden site is located in Goose Lake Township of Grundy County. Goose Lake Township is designated as part of the Metropolitan Chicago Interstate Air Quality Control Region. Goose Lake Township has been classified by the EPA as being in nonattainment with ozone standards (40 CFR 81.314). The Illinois SIP calls for a market-based trading system to control VOCs in the metropolitan Chicago nonattainment area. According to the plan, for every ton of new VOC emissions, 1.3 tons must be removed (Exelon 2003).

  If the coal-fired plant were constructed at the Dresden site, it would be subject to this market-based system. Exelon assumes that a coal-fired alternative would be able to

obtain such offsets (Exelon 2003). If so, the coal-fired alternative would result in lower VOC emissions in the metropolitan Chicago nonattainment area. However, such emissions could easily move outside the area so that there might be an increase in total statewide VOC emissions. Whether there is an increase or not will depend on the nature of the offsets. If the coal-fired plant were constructed at an alternate site in an area considered unclassified or attainment, it would still be subject to EPA regulatory standards discussed above.

Exelon estimates that using the best available control technology, the total annual NO_x emissions for a new coal-fired power plant would be approximately 1561 MT (1721 tons/yr) (Exelon 2003). This level of NO_x emissions might not result in greater statewide emissions, depending on the nature of the credit purchases to cover these emissions. Exelon estimates that annual VOC emissions from the coal-fired alternative would be approximately 188 MT (207 tons/yr). The coal-fired alternative will most likely result in an increase in statewide VOC emissions and certainly in local VOC emissions.

- Particulates. Exelon estimates that the total annual stack emissions would include 216 MT (238 tons) of filterable total suspended particulates (particulates that range in size from less than 0.1 micrometer [μm] up to approximately 45 μm) (Exelon 2003). This would include 50 MT per year (55 tons/yr) of particulate matter having an aerodynamic diameter less than or equal to 10 μm (PM_{10}) (Exelon 2003). Fabric filters, with a 99.9 percent removal efficiency, would be used to control particulates (Exelon 2003). In addition, coal-handling equipment would introduce fugitive particulate emissions.

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

- Carbon monoxide. Exelon estimates that the total carbon monoxide emissions would be approximately 1561 MT (1721 tons/yr) per year (Exelon 2003).

- Hazardous air pollutants including mercury. In December 2000, the EPA issued regulatory findings on emissions of hazardous air pollutants from electric utility steam-generating units (EPA 2000b). EPA determined that coal- and oil-fired electric utility steam-generating units are significant emitters of hazardous air pollutants. Coal-fired power plants were found by EPA to emit arsenic, beryllium, cadmium, chromium, dioxins, hydrogen chloride, hydrogen fluoride, lead, manganese, and mercury (EPA 2000b). EPA concluded that mercury is the hazardous air pollutant of greatest concern. EPA found that (1) there is a link between coal consumption and mercury emissions; (2) electric utility steam-generating units are the largest domestic source of mercury emissions; and (3) certain segments of the U.S. population (e.g., 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 2000b). Accordingly, EPA added coal- and oil-fired electric utility steam-generating units to the list of source categories under Section 112(c) of the Clean Air Act for which emission standards for hazardous air pollutants will be issued (EPA 2000b).

- Uranium and thorium. 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).

- Carbon dioxide. A coal-fired plant would have unregulated carbon dioxide emissions that would contribute to global warming. While these emissions have not traditionally been an important environmental concern, they are becoming increasingly relevant at both a national and an international level.

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

- **Waste**

  Coal combustion generates waste in the form of ash, and equipment for controlling air pollution generates additional ash, spent selective catalytic reduction catalyst, and scrubber sludge. Assuming 99.9 percent ash removal, the three 550-MW(e) coal-fired units would generate approximately 431,000 MT (475,000 tons) of this ash annually (Exelon 2003). According to Exelon, Illinois regulations encourage recycling of coal-combustion byproducts; and Exelon (then Commonwealth Edison) historically recycled 87 percent of its coal ash (Exelon 2003). Assuming continuation of this waste mitigation measure, the coal-fired plant

would generate approximately 56,000 MT (62,000 tons) of ash per year for disposal (Exelon, 2003). In addition, approximately 311,000 MT (343,000 tons) per year of scrubber sludge would be generated by SO_x-control equipment (Exelon 2003). This equipment would use approximately 116,000 tons of calcium oxide (lime) in the scrubbing process to control SO_x emissions.

The waste would be disposed of on-site, accounting for approximately 75 ha (180 ac) of land area over the 40-year plant life, assuming a waste depth of 9 m (30 ft) (Exelon 2003). 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 occur. 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.

In May 2000, the EPA issued a "Notice of Regulatory Determination on Wastes from the Combustion of Fossil Fuels" (EPA 2000a). 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, EPA announced its intention to issue regulations for disposal of coal combustion waste under subtitle D of the Resource Conservation and Recovery Act.

Overall, the waste impacts of the coal-fired alternative at the Dresden site or at an alternate site are considered MODERATE. The impacts would be clearly noticeable but would not destabilize any important resource.

- **Human Health**

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

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

Regulatory agencies, including EPA and State agencies, set air emission standards and requirements based on human health impacts. These agencies also impose site-specific emission limits as needed to protect human health. As discussed previously, EPA has recently concluded that certain segments of the U.S. population (e.g., 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. This characterization holds for a coal-fired generation plant at the Dresden site and at an alternate site.

- **Socioeconomics**

Construction of the coal-fired plant would take approximately five years. The staff assumed that construction would take place while Dresden Units 2 and 3 continued operation and would be completed by the time Dresden Units 2 and 3 permanently ceased operations. The GEIS estimates a peak work force during construction of between 1200 and 2500 workers for a 1000-MW(e) power plant (NRC 1996). This work force would likely be larger for the 1650-MW(e) coal-fired alternative.

If the facility were constructed at the Dresden site, these workers would be in addition to the 870 permanent employees and approximately 120 to 130 contract workers who currently work at the Dresden site. During construction of the new coal-fired plant, surrounding communities would experience demands on housing and public services that could have SMALL to MODERATE impacts. These impacts would be tempered because the Dresden site is part of the economically vital Chicago metropolitan area. After construction, the nearby communities would be impacted by the loss of the construction jobs.

Exelon estimates that the new coal-fired plant would have a workforce of approximately 250 (Exelon 2003). If the coal-fired plant were constructed at the Dresden site and if Dresden Units 2 and 3 were decommissioned, there would be a loss of 620 permanent, high-paying jobs (from 870 for Dresden Units 2 and 3, down to 250 for the coal-fired alternative) along with the loss of 120 to 130 contract workers with a commensurate reduction in demand on

socioeconomic resources and contribution to the regional economy. These impacts may be offset because the Dresden site is in the Chicago metropolitan area. The coal-fired alternative would provide a new tax base to offset the loss of tax base associated with decommissioning of Dresden Units 2 and 3. For all of these reasons, the appropriate characterization of nontransportation socioeconomic impacts for operating a coal-fired plant constructed at the Dresden site is considered SMALL.

The impacts of building the coal-fired plant at an alternate site would depend on the socioeconomic characteristics of the new site. If the site were near a large urban center, as the Dresden site is, then the impacts would be small. On the other hand, in the GEIS, the staff stated that socioeconomic impacts at a rural site would be larger than at an urban site because more of the peak construction workforce would need to move into the area to work (NRC 1996). Alternate sites would, therefore, need to be analyzed on a case-by-case basis. Socioeconomic impacts from construction of the new site could range from SMALL to LARGE, depending on the characteristics of the surrounding regions. Impacts from operating the facility could range from SMALL to MODERATE, depending on the characteristics of the surrounding regions. Grundy County would lose a significant portion of its tax base.

For transportation related to commuting of plant operating personnel, the impacts are considered SMALL. The maximum number of plant operating personnel would be approximately 250 compared to the current permanent workforce of 870 and contract workforce of 130 (Exelon 2003). Therefore, traffic impacts associated with plant personnel commuting to a coal-fired plant would be expect to be SMALL compared to the current impacts from Dresden Units 2 and 3. This would hold for both the Dresden site and an alternate site.

During the five-year construction period for the replacement coal-fired units, a large number of construction workers would be working at the site in addition to the workers currently at the Dresden site. The addition of these workers could place significant traffic loads on existing highways near either the Dresden site or an alternate site. Such impacts would be MODERATE.

At most alternate sites, coal and lime would likely be delivered by rail although barge delivery is feasible for a location on navigable waters. Transportation impacts would depend upon the site location. Socioeconomic impacts associated with rail transportation would likely be MODERATE to LARGE. Barge delivery of coal and lime/limestone would likely have SMALL socioeconomic impacts.

- **Aesthetics**

  The coal-fired power plant units (as much as 60 m [200 ft] tall), and exhaust stack (as much as 120 to 185 m [400 to 600 ft] high) would be visible off-site during daylight hours. Buildings and structures would also be visible at night because of outside lighting. The U.S. Federal Aviation Administration (FAA) generally requires that all structures exceeding an overall height of 61 m (200 ft) above ground level have markings and/or lighting so as not to impair aviation safety (FAA 2000). Visual impacts of buildings and structures could be mitigated by landscaping and by the use of an exterior color for the units that is consistent with the environment. Visual impact at night could be mitigated by reduced use of lighting, provided the lighting meets FAA requirements, and appropriate use of shielding. There would also be impacts from the barge off-loading facility for coal and limestone. At the Dresden site, visual aesthetic impacts are considered MODERATE.

  At an alternate site, cooling towers would be required (up to 160 m [520 ft] high in the case of natural draft towers and up to 30 m [100 ft] high in the case of mechanical draft towers); and these towers and their associated plumes would also be visible off-site. The aesthetic impacts could be mitigated if the plant were located in an industrial area adjacent to other power plants. There would also be significant aesthetic impact from a new transmission line and any rail line needed to deliver coal and lime. Overall, the visual aesthetic impacts associated with a replacement coal-fired power plant at an alternate site are considered MODERATE to LARGE and will depend on the exact location of the alternate site.

  Coal-fired generation would introduce mechanical sources of noise that would be audible off-site. Sources contributing to total noise produced by plant operation are classified as continuous or intermittent. Continuous sources include the mechanical equipment associated with normal plant operations. Intermittent sources include the equipment related to coal handling, solid-waste disposal, transportation related to coal and lime/limestone delivery, use of outside loudspeakers, and the commuting of plant employees. Noise impacts associated with rail delivery of coal and lime/limestone at an alternate site 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 its impact. The noise impacts of a coal-fired plant at the Dresden site are considered to be MODERATE. At an alternate site, these noise impacts would be SMALL to LARGE, depending on the site. Aesthetic impacts at the plant site would be mitigated if the plant were located in an industrial area adjacent to other power plants or industrial facilities.

- **Historic and Archaeological Resources**

  At the Dresden site or an alternate site, a cultural resource inventory would likely be needed for any on-site 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 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 Dresden 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 Dresden site. Other impacts, such as impacts on housing availability and prices during construction, might occur; and this could disproportionately affect minority and low-income populations. Closure of Dresden Units 2 and 3 would result in a decrease in employment of approximately 870 permanent operating employees and 120 to 130 contract employees (same as in the no-action case), but this would be largely offset by construction and operation of the replacement power plant. Resulting economic conditions could reduce employment prospects for minority or low-income populations. However, the Dresden site is located near an active urban area with many employment possibilities. Overall, impacts would be SMALL and would depend on the ability of minority or low-income populations to commute to other jobs outside the area. The impacts around the alternate site would depend upon the site chosen and the nearby population distribution. These impacts could vary between SMALL and LARGE.

8.2.1.2 Open-Cycle Cooling System

The environmental impacts of constructing a coal-fired generation system at an alternate site using an open-cycle cooling system are largely the same as the impacts for a coal-fired plant

using a closed-cycle system. However, there are some environmental differences between the closed-cycle and once-through cooling systems. Table 8-3 summarizes the incremental differences.

Table 8-3. Incremental Impacts of Coal-Fired Generation at an Alternate Site with an Open-Cycle Cooling System Compared to Closed-Cycle Cooling

Impact Category	Change in Impacts from Closed-Cycle Cooling System
Land Use	10 to 12 ha (25 to 30 ac) less land would be required because cooling towers and associated infrastructure are not needed.
Ecology	Impacts would depend on ecology at the site. No impact to terrestrial ecology from cooling-tower drift. Increased water withdrawal with possible greater impact on aquatic ecology.
Surface-water Use and Quality	No discharge of cooling tower blowdown. Increased water withdrawal and more thermal load on receiving body of water.
Groundwater Use and Quality	No change.
Air Quality	No change.
Waste	No change.
Human Health	No change.
Socioeconomics	No change.
Aesthetics	Reduced aesthetic impact because cooling towers would not be used.
Historic and Archaeological Resources	Impacts would depend on the cultural resources identified at the site.
Environmental Justice	No change.

8.2.2 Natural Gas-Fired Generation

The environmental impacts of the natural gas alternative are examined in this section. Unless otherwise indicated, the assumptions and numerical values used in this section are from the

Exelon ER (Exelon 2003). The staff reviewed this information and compared it to environmental impact information in the GEIS as well as other relevant information and sources when appropriate. 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. The staff assumed that Dresden Units 2 and 3 would remain in operation while the natural gas-fired plant was constructed.

Consistent with the Exelon ER (Exelon 2003), the staff assumed a combined-cycle[(a)] natural gas facility based on three 550-MW(e) combined-cycle units, for a total facility size of 1650 MW(e) (Exelon 2003).[(b)] The 550-MW(e) units are a standard size; their use would minimize the cost of the new facility. Any shortfall in capacity would be made up from other sources. This assumption understates the environmental impacts of replacing the 1824 MW(e) from Dresden Units 2 and 3. As a rough estimate, if a natural gas-fired plant of exactly 1824 MW(e) were to be built, any numerical impacts in this section might simply be adjusted upwards accordingly. However, given these adjustments, the staff has determined that the differences in impacts between 1650 MW(e) and 1824 MW(e) of coal-fired generation would not be significant and would not change the impact levels.

The natural gas-fired alternative is analyzed both for the existing Dresden site and for an unnamed alternate site. Siting a new natural gas-fired plant where an existing nuclear plant is located would result in fewer impacts. Hence, although the staff considered an alternate site, it is unlikely that it would be beneficial to place a new natural gas-fired facility at an alternate site based purely on environmental grounds. The GEIS estimates that 45 ha (110 ac) would be required for a new 1000-MW(e) combined-cycle facility, a much smaller land requirement than for a new coal-fired facility. Exelon concluded in its ER that the Dresden site would be a reasonable site for location of a natural gas-fired generating unit (Exelon 2003). Locating the natural gas-fired alternative at an existing nuclear site would allow the new facility to take advantage of existing infrastructure at the Dresden site, including existing cooling system, switchyard, offices, intake and discharge, and transmission rights-of-way.

Exelon made the following estimates to describe the combined-cycle facility:

(a) 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.
(b) The natural gas-fired units would have a rating of 572 gross MW(e) and 550 net MW(e). The difference between “gross” and “net” is the electricity consumed on-site.

- Heat rate: 6120 Btu/kWh (Exelon 2003)
- Natural gas heating value: 1021 Btu/ft^3 (Exelon 2003)
- Capacity factor: 0.85 (Exelon 2003).

These assumptions were deemed by the staff to be consistent with current practice with combined-cycle facilities. For emissions control, the facility would be outfitted with standard technologies, which includes selective catalytic reduction and steam/water injection for NO_x control.

Operation of a new combined-cycle facility at the Dresden site would require a new gas line. Exelon estimated that approximately 3 km (2 mi) of 41-cm (16-in.) gas pipeline would be required (Exelon 2003). Exelon further estimated that this pipeline would require approximately 15 to 16 ha (36 to 40 ac) for an easement (Exelon 2003). The gas line requirements at an alternate site would depend on the characteristics and location of the alternate site.

8.2.2.1 Closed-Cycle Cooling System

For purposes of this SEIS, the staff assumed a natural gas-fired plant would use the existing modified, closed-cycle cooling system at the Dresden site, or at least some portion of this system because the water requirements for a combined-cycle facility are significantly lower than those for a coal-fired facility or a nuclear facility. The existing system is discussed above in Section 8.2.1.1.

The overall impacts of the natural gas-fired generating system using the existing, modified closed-cycle system at the Dresden site and at an alternate site are discussed in the following sections and summarized in Table 8-4. For completeness, the staff also considered the impacts of a fully open-cycle cooling system with no cooling pond. An open-cycle system might be considered if the natural gas-fired alternative were built at an alternate site. Additional impacts from the use of an open-cycle cooling system are considered in Section 8.2.1.2. The extent of impacts from an alternate site would depend on the location.

- **Land Use**

  For siting a new facility at the Dresden site, the existing infrastructure would be used to the extent practicable, thus limiting the amount of new construction that would be required. Specifically, the staff assumed that the new combined-cycle facility would make use of the existing cooling system, switchyard, offices, and transmission rights-of-way. The GEIS assumes that approximately 45 ha (110 ac) would be needed for a 1000-MW(e) natural gas facility (NRC 1996). Scaling up for the 1650-MW(e) facility considered by Exelon would increase the land requirement to about 74 ha (180 ac). According to Exelon, previously disturbed acreage already exists and is available at the Dresden site, minimizing land-use impacts (Exelon 2003).

Table 8-4. Summary of Environmental Impacts of Natural Gas-Fired Generation at the Dresden Site and an Alternate Site Using a Closed-Cycle Cooling System

	Dresden Site		Alternate Site	
Impact Category	**Impact**	**Comments**	**Impact**	**Comments**
Land Use	SMALL to MODERATE	Upwards of 45 ha (110 ac) for power block, offices, roads, and parking areas. Additional impact for construction of underground gas pipeline.	SMALL to LARGE	Upwards of 45 ha (110 ac) for power block, offices, roads, and parking areas. Additional impact for construction and/or upgrade of an underground gas pipeline, if required, along with any needed transmission lines.
Ecology	SMALL to MODERATE	Would use undeveloped areas at Dresden site. There would be potential for habitat loss and fragmentation and reduced productivity and biological diversity.	SMALL to LARGE	Impact would depend on location and ecological conditions of site and transmission line route. There would be potential for habitat loss and fragmentation and reduced productivity and biological diversity.
Water Use and Quality	SMALL	Cooling water requirements would be significantly lower than with nuclear or coal-fired alternatives. If needed, could use existing modified closed-cycle cooling system. Facility would continue current limited groundwater use.	SMALL to MODERATE	Impact would depend on volume of water withdrawal and discharge, and the characteristics of surface water or groundwater source.

Table 8-4. (contd)

Impact Category	Dresden Site		Alternate Site	
	Impact	**Comments**	**Impact**	**Comments**
Air Quality	MODERATE	Sulfur oxides: 121 MT/yr (133 tons/yr) Nitrogen oxides: 386 MT/yr (426 tons/yr). Impact depends on emissions offsets. Carbon monoxide: 80 MT/yr (88 tons/yr) Particulates: 74 MT/yr (82 tons/yr) PM_{10} Other: CO_2 emissions contribute to global warming.	MODERATE	Same emissions as Dresden site, although offsets for NO_x would depend on location.
Waste	SMALL	Minimal waste product from fuel combination.	SMALL	Impacts identical to those for Dresden site.
Human Health	SMALL	Impacts considered to be minor.	SMALL	Impacts identical to those for Dresden site.

Table 8-4. (contd)

Impact Category	Dresden Site		Alternate Site	
	Impact	**Comments**	**Impact**	**Comments**
Socioeconomics	SMALL to MODERATE	During construction, impacts would be SMALL. Peak workforce during 2- to 3-year construction period would be significantly smaller than for other steam-generation facilities.	SMALL to MODERATE	Construction impacts at alternate site would be similar to those at Dresden site, but would depend on whether new site is located near a major metropolitan area.
		During operation, employment would be reduced from approximately 1000 permanent and contract workers to approximately 50. All employment impacts would be tempered by proximity to Chicago metropolitan area. New tax base would offset loss of current tax base.		Grundy County would lose significant portion of tax base.
		Transportation impacts during operation would be SMALL due to the smaller workforce. Transportation impacts associated with construction workers would be SMALL to MODERATE.		Transportation impacts would be similar to those at Dresden site.

Table 8-4. (contd)

Impact Category	Dresden Site		Alternate Site	
	Impact	Comments	Impact	Comments
Aesthetics	MODERATE	MODERATE aesthetic impact due to impact of plant buildings and structures along with noise impact from plant operation.	MODERATE to LARGE	Impact would depend on location. Greatest impact likely would be from the new transmission line(s) that would be needed.
Historic and Archaeological Resources	SMALL to MODERATE	Studies would likely be needed to identify, evaluate, and address mitigation of the potential impacts of new plant construction on cultural resources.	SMALL to MODERATE	Alternate location would necessitate cultural studies to identify, evaluate, and address mitigation of the potential impacts of new plant construction on cultural resources at developed and undeveloped sites.
Environmental Justice	SMALL	No environmental pathways or locations have been identified that would result in disproportionately high and adverse environmental impacts on minority and low-income populations. Impacts on minority and low-income communities should be similar to those experienced by the population as a whole. Any impacts would be tempered by proximity to the Chicago area.	SMALL to LARGE	Impacts vary depending on population distribution and characteristics at new site. Impacts on Dresden site would be identical to those in the no-action alternative.

If a natural gas-fired facility were built at the Dresden site, there would be an additional land requirement to bring in enough gas to supply the combined-cycle facility. As stated previously, Exelon estimated that approximately 3 km (2 mi) of 41-cm (16-in.) gas pipeline would be required (Exelon 2003). Exelon further estimated that this pipeline would require approximately 15 to 16 ha (36 to 40 ac) for an easement (Exelon 2003). Exelon asserts that this would likely be of only minimal impact because Exelon would use best management practices during construction, such as minimizing soil loss and restoring vegetation immediately after the excavation is backfilled (Exelon 2003).

For construction at an alternate site, the full land requirement for a natural gas-fired facility would be required because no existing infrastructure would be available. Additional land could be impacted for construction of a transmission line and natural gas and oil pipelines to serve the plant.

Regardless of whether the natural gas facility is built at the Dresden site or at an alternate site, additional land could be required for natural gas wells and collection stations. In the GEIS, the staff estimated that approximately 1500 ha (3600 ac) would be needed for a 1000-MW(e) plant (NRC 1996). Proportionately more land would be needed for the 1650-MW(e) facility considered here. Partially offsetting these off-site land requirements would be the elimination of the need for uranium mining to supply fuel for Dresden Units 2 and 3. In the GEIS (NRC 1996), the staff estimated that approximately 400 ha (1000 ac) would be affected for mining the uranium and processing it during the operating life of a 1000-MW(e) nuclear power plant.

Overall, the land-use impacts of constructing the natural gas-fired plant at the Dresden site are considered SMALL to MODERATE. Overall, the land-use impacts would depend on the chosen site but are characterized as SMALL to LARGE.

- **Ecology**

Locating a natural gas-fired plant at the Dresden site would affect ecological resources because approximately 74 ha (183 ac) of currently unused land would be converted to industrial use. Impacts to terrestrial ecology would be somewhat reduced because some of the area to be developed would be land previously disturbed by site activities and thus of less ecological value. A new gas pipeline would require an easement of 15 to 16 ha (36 to 40 ac). Exelon asserts the new gas pipeline would likely be of only minimal impact because best management practices, such as minimizing soil loss and restoring vegetation immediately after the excavation is backfilled, would be used during construction (Exelon 2003). Impacts to ecological resources could include on-site habitat degradation, fragmentation, habitat loss, reduced ecosystem productivity, and a reduction in biological diversity. The use of a closed-cycle cooling system would reduce operational impacts on

the aquatic ecosystem and would reduce the use of water below current levels. Overall, the ecological impacts of the natural gas-fired alternative at the Dresden site are considered SMALL to MODERATE.

At an alternate site, the construction and operation of a natural gas-fired plant would result in some ecological impacts. Impacts to ecological resources could include habitat degradation, fragmentation, habitat loss, reduced ecological productivity and a reduction in biological diversity. If needed, construction and maintenance of new transmission line(s) and gas-supply line would have similar ecological impacts. Use of make-up cooling water from a nearby surface-water body could have adverse aquatic resource impacts. Overall, the ecological impacts of the natural gas-fired alternative at an alternate site are dependent on whether a site had been previously developed (SMALL to MODERATE) or is an undeveloped greenfield site (MODERATE to LARGE impact).

- **Water Use and Quality**

Each of the natural gas-fired units would include a heat recovery boiler from which steam would turn an electric generator. Steam would be condensed and circulated back to the boiler for reuse. Overall, water requirements for combined-cycle generation are much less than for conventional, closed-cycle steam electric generators. The natural gas-fired alternative at the existing site would use the existing modified, closed-cycle cooling system and would, therefore, have no incremental impacts on cooling-water needs. Some erosion and sedimentation probably would occur during construction (NRC 1996). The three groundwater wells that supply limited specific uses at the Dresden site would continue to be used. Overall, the impacts of the natural gas-fired alternative at the Dresden site are considered SMALL.

At an alternate site, the cooling water would likely be drawn from a surface body of water. The impact would depend upon the amount of water withdrawn. Plant discharges would consist mostly of cooling tower blowdown, characterized primarily by an increased temperature and increased concentration of dissolved solids relative to the receiving body of water and intermittent low concentrations of biocides (e.g., chlorine). Treated process waste streams and sanitary wastewater may also be discharged. All discharges would likely be regulated through a NPDES permit. Use of groundwater for a natural gas-fired plant at an alternate site is a possibility. There would be consumptive use of water due to evaporation from the cooling towers. Some erosion and sedimentation probably would occur during construction (NRC 1996). Overall, the impacts at an alternate site are considered SMALL to MODERATE.

- **Air Quality**

  Natural gas is a relatively clean-burning fuel. The natural 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 type of air quality regulations as a coal-fired plant, discussed in Section 8.2.1.1. The greatest concern from combined-cycle facilities are the emissions of ozone precursors, NO_x and VOCs.

  Exelon projects the following emissions for the natural gas-fired alternative (Exelon 2003):

  Sulfur oxides: 121 MT/yr (133 tons/yr)
  Nitrogen oxides: 386 MT/yr (426 tons/yr)
  Carbon monoxide: 80 MT/yr (88 tons/yr)
  PM_{10} particulates: 67 MT/yr (74 tons/yr)
  Volatile organic compounds: 74 MT/yr (82 tons/yr).

  A combined-cycle facility would also have unregulated carbon dioxide emissions that could contribute to global warming. While these emissions have not traditionally been an important environmental concern, they are becoming increasingly relevant at both a national and an international level.

  In December 2000, EPA issued regulatory findings on emissions of hazardous air pollutants from electric utility steam-generating units (EPA 2000b). Natural gas-fired power plants were found by EPA to emit arsenic, formaldehyde, and nickel (EPA 2000b). Unlike coal- and oil-fired plants, 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.

  The preceding emissions would likely be largely the same at the Dresden site or at an alternate site. Impacts 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-fired generating facility sited at the Dresden site or an alternate site is considered MODERATE.

- **Waste**

  Burning natural gas results in very few combustion by-products because of the clean nature of the fuel. There would be small amounts of solid waste products (i.e., ash)

from burning natural gas fuel. In the GEIS, the staff concluded that waste generation from gas-fired technology would be minimal (NRC 1996). Waste generation at an operating gas-fired plant would be largely limited to typical office wastes. Construction-related debris would be generated during construction activities. Overall, the waste impacts would be SMALL for a natural gas-fired plant sited at the Dresden site or at an alternate site.

- **Human Health**

  In the GEIS, the staff identifies cancer and emphysema as potential health risks from gas-fired plants (NRC 1996). The risk may be attributable to NO_x emissions that contribute to ozone formation, which in turn contribute to health risks. NO_x emissions from the plant would be regulated. As discussed in Section 8.2.1.1, NO_x emissions for a new combined-cycle plant at the Dresden site would be offset through the Emissions Reduction Trading Program because the Dresden site is in the Metropolitan Chicago Ozone Nonattainment Area. 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 are considered SMALL at the Dresden site or at an alternate site.

- **Socioeconomics**

  Construction of a natural gas combined-cycle facility would take approximately two to three years. The staff assumed that construction would take place while Dresden Units 2 and 3 continued operation and would be completed by the time they permanently ceased operations. In the GEIS (NRC 1996), the staff concluded that socioeconomic impacts from constructing a natural gas-fired power plant would be low compared to other steam plants.

  If the facility were constructed at the Dresden site, construction workers would be in addition to the 870 permanent employees and approximately 120 to 130 contract workers who currently work at the Dresden site. During construction, the communities immediately surrounding the Dresden site would experience demands on housing and public services that would have SMALL impacts. These impacts would be tempered because construction workers would commute to the site from a wider range of cities and towns comprising the Chicago metropolitan area. After construction, the nearby communities would be impacted by the loss of the construction jobs.

Exelon estimates that the new combined-cycle facility would have a workforce of approximately 25 to 40 (Exelon 2003), significantly fewer than the 150 assumed in the GEIS for a 1000-MW(e) natural gas facility. If it is assumed that such a facility would require a workforce of approximately 50 workers, that the combined-cycle facility would be constructed at the Dresden site, and that Dresden Units 2 and 3 were decommissioned, there would be a loss of 820 permanent, high-paying jobs (from 870 jobs for Dresden Units 2 and 3, down to 50 for a natural gas alternative) along with the loss of 120 to 130 contract workers with a commensurate reduction in demand on socioeconomic resources and contribution to the regional economy. These impacts would be tempered because the Dresden site is within the economically vital Chicago metropolitan area. The natural gas alternative would provide a new tax base to offset the loss of the tax base associated with the decommissioning of Dresden Units 2 and 3. For all of these reasons, the appropriate characterization of nontransportation socioeconomic impacts for operating a natural gas plant constructed at the Dresden site is considered SMALL.

If the alternative natural gas-fired power plant were constructed at an alternate site, there would be impacts for areas around the Dresden site (from losing a facility) and around the alternate site (from gaining a facility). Grundy County would lose a significant portion of its tax base. The impacts around the alternate site would depend on the socioeconomic characteristics of the new site. If the site were near a large urban center, as the Dresden site is, then the impacts would be small. On the other hand, socioeconomic impacts at a rural site would be larger than at an urban site because more of the peak construction workforce would need to move into the area to work (NRC 1996). Alternate sites would, therefore, need to be analyzed on a case-by-case basis. Socioeconomic impacts from construction of the new site could range from SMALL to MODERATE, depending on the characteristics of the surrounding regions. Impacts from operating the facility would likely be SMALL.

For transportation related to commuting of plant operating personnel, the impacts are considered small. The number of plant operating personnel would be small compared to the current workforce of 870 (Exelon 2003). Therefore, traffic impacts associated with plant personnel commuting to a natural gas plant would be expect to be SMALL compared to the current impacts from Dresden Units 2 and 3. This would hold at both the Dresden site and at an alternate site.

During the construction period for the replacement natural gas-fired units, a significant cadre of construction workers would be working at the site in addition to the 870 permanent and 130 contract workers currently at the Dresden site. The addition of these workers could place significant traffic loads on existing highways

near the Dresden site. Such impacts would be SMALL to MODERATE. At an alternate site, such impacts are also considered SMALL to MODERATE.

- **Aesthetics**

  The turbine buildings, the exhaust stacks (approximately 60 m [200 ft] tall), and the gas pipeline compressors would be visible off-site during daylight hours. Buildings and structures would also be visible at night because of outside lighting. Visual impacts of buildings and structures could be mitigated by landscaping and by selecting an exterior color for the units that is consistent with the environment for the facility. Visual impact at night could be mitigated by reduced use of lighting and appropriate use of shielding. At the Dresden site, visual aesthetic impacts of a natural gas combined-cycle facility are considered MODERATE. At an alternate site, cooling towers would be required; and these towers and their associated plumes would also be visible off-site. The aesthetic impacts could be mitigated if the plant were located in an industrial area adjacent to other industrial plants. There would also be significant aesthetic impact from a new transmission line. Overall, the aesthetic impacts associated with a replacement natural gas-fired power plant at an alternate site are considered MODERATE to LARGE and will depend on the exact location of the alternate site.

  Natural gas generation would introduce mechanical sources of noise that would be audible off-site. 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 use of outside loudspeakers and the commuting of plant employees. The incremental noise impacts of a natural gas-fired plant compared to existing operations at the Dresden site are considered to be MODERATE. At an alternate site, these noise impacts would be SMALL to LARGE, depending on the site and location. Again, the aesthetic impacts at the plant site would be mitigated if the plant were located in an industrial area adjacent to other power plants or industrial facilities.

- **Historic and Archaeological Resources**

  At the Dresden site or an alternate site, a cultural resource inventory would likely be needed for any on-site 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 Dresden 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 natural gas-fired plant were built at the Dresden site. Other impacts, such as impacts on housing availability and prices during construction, might occur; and this could disproportionately affect minority and low-income populations. Closure of Dresden Units 2 and 3 would result in a decrease in employment of approximately 870 permanent operating employees and 120 to 130 contract employees (same as in the no-action case), offset by construction and operation of the replacement power plant. Resulting economic conditions could reduce employment prospects for minority or low-income populations. However, the Dresden site is located near an active urban area with many employment possibilities. Overall, impacts would be SMALL and would depend on the ability of minority or low-income populations to commute to other jobs outside the area. The impacts around the alternate site would depend upon the site chosen and the nearby population distribution. These impacts could vary between SMALL and LARGE.

8.2.2.2 Open-Cycle Cooling System

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

Table 8-5. Incremental Impacts of Natural Gas-Fired Generation at an Alternate Site with an Open-Cycle Cooling System Compared to Closed-Cycle Cooling

Impact Category	Change in Impacts from Closed-Cycle Cooling System
Land Use	10 to 12 ha (25 to 30 ac) less land required because cooling towers and associated infrastructure are not needed.
Ecology	Impacts would depend on ecology at the site. No impact to terrestrial ecology from cooling tower drift. Increased water withdrawal with possible greater impact on aquatic ecology.
Surface-water Use and Quality	No discharge of cooling tower blowdown. Increased water withdrawal and more thermal load on receiving body of water.
Groundwater Use and Quality	No change.
Air Quality	No change.
Waste	No change.
Human Health	No change.
Socioeconomics	No change.
Aesthetics	Reduced aesthetic impact because cooling towers would not be used.
Historic and Archaeological Resources	Impacts would depend on the cultural resources identified at the site.
Environmental Justice	No change.

8.2.3 Nuclear Power Generation

Since 1997, the NRC has certified three new standard designs for nuclear power plants under 10 CFR Part 52, Subpart B. These designs are the U.S. Advanced Boiling Water Reactor (10 CFR Part 52, Appendix A), the System 80+ Design (10 CFR Part 52, Appendix B), and the AP600 Design (10 CFR Part 52, Appendix C). All of these plant designs are light-water reactors. Although no applications for a construction permit or a combined license based on these certified designs have been submitted to the NRC, the submission of the design certification applications indicates continuing interest in the

possibility of licensing new nuclear power plants. Recent volatility in prices of natural gas and electricity has made new nuclear power plant construction more attractive from a cost standpoint. Additionally, System Energy Resources, Inc.; Exelon Generation Company, LLC; and Dominion Nuclear North Anna, LLC, have recently submitted applications for early site permits to set aside site(s) for one or more nuclear power plants under the procedures in 10 CFR Part 52, Subpart A (SERI 2003; Dominion 2003; Exelon 2003b). Therefore, construction of a new nuclear plant, either at the Dresden site or at an alternate site in Illinois using both closed and open-cycle cooling, is considered in this section.

The staff assumed that the new nuclear plant would have a 40-year lifetime.

The NRC 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 and sited at Dresden or at 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 Dresden Units 2 and 3, which have a net capacity of 1824 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 the NRC's findings on NEPA issues for license renewal of nuclear power plants in Table B-1 of 10 CFR Part 51, Subpart A, Appendix B, is also relevant although not directly applicable, for consideration of environmental impacts associated with the operation of a replacement nuclear power plant. Additional environmental impact information for a replacement nuclear power plant using closed-cycle cooling is presented in Section 8.2.3.1 and using open-cycle cooling in Section 8.2.3.2.

8.2.3.1 Closed-Cycle Cooling System

For purposes of this SEIS, the staff assumed a nuclear plant would use the existing modified, closed-cycle cooling system at the Dresden site. The existing system is discussed above in Section 8.2.1.1.

The overall impacts of the nuclear generating system using the existing, modified closed-cycle system at the Dresden site and at an alternate site are discussed in the following sections and summarized in Table 8-6. For completeness, the staff also considered the impacts of a fully open-cycle cooling system with no cooling pond. An open-cycle system might be considered if the nuclear plant were built at an alternate site. Additional impacts from the use of an open-cycle cooling system are considered in Section 8.2.1.2. The magnitude of impacts from an alternate site would depend on the location.

Table 8-6. Summary of Environmental Impacts of New Nuclear Power Generation at the Dresden Site and Alternate Site Using Closed-Cycle Cooling System

	Dresden Site		Alternate Site	
Category	**Impact**	**Comments**	**Impact**	**Comments**
Land Use	MODERATE	Would use unused areas of Dresden site and possibly adjacent unused lands. Would require approximately 200 to 400 ha (500 to 1000 ac) for the plant. Plant would use any existing infrastructure (e.g., transmission lines) to the extent practicable.	MODERATE to LARGE	Same as Dresden site, plus land for transmission lines and rail or barge facilities.
Ecology	MODERATE	Would use undeveloped areas at Dresden site, and possibly adjacent unused lands. There would be potential for habitat loss and fragmentation and reduced productivity and biological diversity.	MODERATE to LARGE	Impact would depend on location and ecological conditions of site and transmission line route. There would be potential for habitat loss and fragmentation and reduced productivity and biological diversity.
Water Use and Quality	SMALL	Would use existing modified closed-cycle cooling system and continue current limited groundwater use.	SMALL to MODERATE	Impact would depend on volume of water withdrawal, the constituents of the discharge water, and the characteristics of surface-water body or groundwater source.

Table 8-6. (contd)

	Dresden Site		Alternate Site	
Category	**Impact**	**Comments**	**Impact**	**Comments**
Air Quality	SMALL	Fugitive emissions and emissions from vehicles and equipment during construction. Small amount of emissions from diesel generators. Emissions would be similar to current releases.	SMALL	Same impacts as at Dresden site.
Waste		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	
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 at Dresden site.

Table 8-6. (contd)

	Dresden Site		Alternate Site	
Category	**Impact**	**Comments**	**Impact**	**Comments**
Socioeconomics	SMALL to MODERATE	During construction, impacts would be SMALL to MODERATE. Upwards of 2500 workers might be required at peak of the 5-year construction period.	SMALL to LARGE	Construction impacts at alternate site would be similar to those at Dresden site, but would depend on whether new site is located near a major metropolitan area.
		During operation, employment would be similar to current employment. Tax base would be preserved.		Grundy County would lose significant portion of tax base.
		Transportation impacts during operation would be SMALL due to the smaller workforce. Transportation impacts associated with construction workers would be SMALL to MODERATE.		Transportation impacts would be similar to those at Dresden site.
Aesthetics	MODERATE	Moderate aesthetic impact due to impact of nuclear plant buildings and structures along with noise impacts from plant operation.	MODERATE to LARGE	Impacts would similar to those at Dresden site but would also include any aesthetic impacts from building new transmission line(s).
Historic and Archaeological Resources	SMALL to MODERATE	Studies would likely be needed to identify, evaluate, and address mitigation of the potential impacts of new plant construction on cultural resources.	SMALL to MODERATE	Alternate location would necessitate cultural studies to identify, evaluate, and address mitigation of the potential impacts of new plant construction on cultural resources at developed and undeveloped sites.

Table 8-6. (contd)

	Dresden Site		Alternate Site	
Category	**Impact**	**Comments**	**Impact**	**Comments**
Environmental Justice	SMALL	No environmental pathways or locations have been identified that would result in disproportionately high and adverse environmental impacts on minority and low-income populations. Impacts on minority and low-income communities would be similar to those experienced by the population as a whole.	SMALL to LARGE	Impacts vary depending on population distribution and characteristics at new site. Impacts on Dresden site would be identical to those in the no-action alternative.

- **Land Use**

  According the GEIS, a light-water reactor requires approximately 200 to 400 ha (500 to 1000 ac) excluding transmission lines. Because a large portion of the Dresden site is used for the cooling pond, some off-site land may be required to support a new nuclear facility. For siting a new facility, the existing infrastructure would be used to the extent practicable, thus limiting the amount of new construction and off-site land that would be required. Specifically, the staff assumed that the new nuclear facility would use the existing cooling system, switchyard, offices, and transmission rights-of-way.

  There would be no net change in land needed for uranium mining because land needed to supply the new nuclear plant would offset land needed to supply uranium for fueling the existing reactors at Dresden Units 2 and 3. Overall, the impact of a replacement nuclear generating plant on land use at the existing Dresden site is best characterized as MODERATE.

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

- **Ecology**

  Locating a new nuclear power plant at the Dresden site would affect ecological resources because approximately 200 to 400 ha (500 to 1000 ac) of currently unused land and possibly some neighboring unused land would be converted to industrial use. Impacts to terrestrial ecology would be somewhat reduced because some of the area to be developed would be land previously disturbed by site activities and thus of less ecological value. Impacts to ecological resources could include habitat degradation, fragmentation, habitat loss, reduced ecosystem productivity, and a reduction in biological diversity. Use of a closed-cycle cooling system would reduce impacts to the aquatic ecosystem. Siting a new nuclear power plant at the Dresden site would have MODERATE ecological impact, primarily due to construction.

  At an alternate site, the construction and operation of a new nuclear power plant would result in ecological impacts. Impacts to ecological resources could include habitat degradation, fragmentation, habitat loss, reduced ecological productivity and a reduction in biological diversity. If needed, construction and maintenance of a transmission line would have similar ecological impacts. Overall, the ecological impacts are dependent on whether a site had been previously developed (MODERATE) or is an undeveloped greenfield site (MODERATE to LARGE impact).

- **Water Use and Quality**

  The nuclear alternative at the existing site would use the existing modified, closed-cycle cooling system and would, therefore, have no incremental impacts on cooling water needs. Some erosion and sedimentation probably would occur during construction (NRC 1996). The three groundwater wells that supply limited specific uses at the Dresden site could continue to be used. Overall, the impacts of the nuclear alternative at the Dresden site are considered SMALL, depending on the location.

  At an alternate site, the cooling water would likely be drawn from a surface body of water. Plant discharges would consist mostly of cooling tower blowdown, characterized primarily by an increased temperature and concentration of dissolved solids relative to the receiving body of water and intermittent low concentrations of biocides (e.g., chlorine). Treated process waste streams and sanitary wastewater may also be discharged. All discharges would likely be regulated through a NPDES permit. Use of groundwater for a nuclear plant at an alternate site is a possibility. There would be consumptive use of water due to evaporation from the cooling towers. Some erosion and sedimentation probably would occur during construction (NRC 1996). Overall, the impacts at an alternate site are considered SMALL to MODERATE, depending on the location.

- **Air Quality**

  Construction of a new nuclear plant at the Dresden site or an alternate site would result in fugitive emissions during the construction process. Exhaust emissions would also come from vehicles and motorized equipment used during the construction process. An operating nuclear plant would have minor air emissions associated with emergency diesel generators. These emissions would be regulated. Overall, emissions and associated impacts at either the Dresden site or an alternate site would be similar to current releases and are considered SMALL.

- **Waste**

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

- **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 at either the Dresden site or an alternate site.

- **Socioeconomics**

  The construction period and the peak work force associated with construction of a new nuclear power plant are currently unquantified (NRC 1996). In the absence of quantified data, the staff assumed a construction period of five years and a peak work force of 2500. The staff assumed that construction would take place while Dresden Units 2 and 3 continued operation and would be completed by the time Dresden Units 2 and 3 permanently cease operations.

  If the facility were constructed at the Dresden site, these workers would be in addition to the 870 permanent employees and the approximately 120 to 130 contract workers that currently work at the Dresden site. During construction of the new nuclear power plant, surrounding communities would experience demands on housing and public services that could have MODERATE impacts. These impacts would be tempered because the Dresden site is part

of the economically vital Chicago metropolitan area. After construction, the nearby communities would be impacted by the loss of the construction jobs.

The replacement nuclear units are assumed to have an operating work force comparable to the approximately 1000 workers currently working at Dresden Units 2 and 3. The alternative new nuclear power plant would provide a new tax base to offset the loss of tax base associated with decommissioning of Dresden Units 2 and 3. For all of these reasons, the appropriate characterization of nontransportation, socioeconomic impacts for operating a new nuclear power plant constructed at the Dresden site is considered SMALL.

If the alternative new nuclear power plant were constructed at an alternate site, the impacts around the alternate site would depend on the socioeconomic characteristics of the new site. If the site were near a large urban center, as the Dresden site is, then the impacts would be small. On the other hand, in the GEIS, the staff stated that socioeconomic impacts at a rural site would be larger than at an urban site because more of the peak construction workforce would need to move into the area to work (NRC 1996). Alternate sites would, therefore, need to be analyzed on a case-by-case basis. Socioeconomic impacts from construction of the new site could range from SMALL to LARGE, depending on the characteristics of the surrounding regions. Impacts from operating the facility could range from SMALL to MODERATE, depending on the characteristics of the surrounding regions. Grundy County would lose a significant portion of its tax base.

For transportation related to commuting of plant operating personnel, the impacts are considered small. The number of personnel would be similar to the number currently working at the Dresden site. Therefore, traffic impacts associated with plant personnel commuting to a new nuclear power plant would be expect to be SMALL compared to the current impacts from Dresden Units 2 and 3. This would hold for both the Dresden site and an alternate site.

During the five-year construction period for the replacement new nuclear power plant, however, a large number of construction workers would be working at the site in addition to the workers currently at the Dresden site. The addition of these workers could place significant traffic loads on existing highways near either the Dresden site or an alternate site. Such impacts would be MODERATE.

- **Aesthetics**

The containment buildings for a replacement nuclear power plant and other associated buildings would be visible from surrounding areas during daylight hours. Buildings and structures would also be visible at night because of outside lighting. Visual impacts of

buildings and structures could be mitigated by landscaping and by selecting an exterior color for the units that is consistent with the environment. Visual impact at night could be mitigated by reduced use of lighting and appropriate use of shielding. At the Dresden site, visual aesthetic impacts are considered MODERATE. At an alternate site, cooling towers would be required, and these towers and their associated plumes would also be visible off-site. The aesthetic impacts could be mitigated if the plant were located in an industrial area adjacent to other power plants. There would also be significant aesthetic impact from a new transmission line. Overall, the aesthetic impacts associated with a replacement nuclear-fired power plant at an alternate site are considered MODERATE to LARGE and will depend on the exact location of the alternate site.

Nuclear generation would introduce mechanical sources of noise that would be audible off-site. 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 use of outside loudspeakers and the commuting of plant employees. The incremental noise impacts of a nuclear-fired plant compared to existing operations at the Dresden site are considered to be MODERATE. At an alternate site, these noise impacts would be SMALL to LARGE, depending on the site. Again, aesthetic impacts at the plant site would be mitigated if the plant were located in an industrial area adjacent to other power plants or industrial facilities.

- **Historic and Archaeological Resources**

  At the Dresden site or an alternate site, a cultural resource inventory would likely be needed for any on-site 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 Dresden 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 new nuclear power plant were built at the Dresden site. Other impacts, such as impacts on housing availability and prices during construction, might occur during construction; and these impacts could disproportionately affect minority and low-income populations. Closure of Dresden Units 2 and 3 would result in a decrease in employment of approximately 870 permanent operating employees and 120 to 130 contract employees (same as in the no-action case), but this would be offset by construction and operation of the replacement power plant. Resulting economic conditions could reduce employment prospects for minority or low-income populations; however, the Dresden site is located near an active urban area with many employment possibilities. Overall, impacts would be SMALL and would depend on the ability of minority or low-income populations to commute to other jobs outside the area. The impacts around the alternate site would depend upon the site chosen and the nearby population distribution. These impacts could vary between SMALL and LARGE.

8.2.3.2 Open-Cycle Cooling System

The environmental impacts of constructing a nuclear generation system at an alternate site using an open-cycle cooling system are largely the same as the impacts for a nuclear generation system using a closed-cycle system. However, there are some environmental differences between the closed-cycle and once-through cooling systems. Table 8-7 summarizes the incremental differences.

Table 8-7. Incremental Impacts of Nuclear Power Generation at an Alternate Site with Open-Cycle Cooling Compared to Closed-Cycle Cooling

Impact Category	Change in Impacts from Closed-Cycle Cooling System
Land Use	10 to 12 ha (25 to 30 ac) less land required because cooling towers and associated infrastructure are not needed.
Ecology	Impacts would depend on ecology at the site. No impact to terrestrial ecology from cooling tower drift. Increased water withdrawal with possible greater impact on aquatic ecology.
Surface-water Use and Quality	No discharge of cooling tower blowdown. Increased water withdrawal and more thermal load on receiving body of water.
Groundwater Use and Quality	No change.

Table 8-7. (contd)

Impact Category	Change in Impacts from Closed-Cycle Cooling System
Air Quality	No change.
Waste	No change.
Human Health	No change.
Socioeconomics	No change.
Aesthetics	Reduced aesthetic impact because cooling towers would not be used.
Historic and Archaeological Resources	Impacts would depend on the cultural resources identified at the site.
Environmental Justice	No change.

8.2.4 Purchased Electrical Power

This section considers the option of Exelon decommissioning Dresden Units 2 and 3, not replacing the lost generation with a new power plant or other option, and then purchasing an equal amount of power and capacity to replace that generated by Dresden Units 2 and 3. There are two possibilities for the source of this power. On the one hand, this replacement power could come from facilities that are already built but not producing power. On the other hand, replacement power could come from new generation facilities. The likely outcome would be a combination of both sources. Initially, replacement power would come from existing sources. Under normal economic conditions, the use of replacement power will raise the price of capacity and energy because the supply will be lowered, but the demand will remain the same. Over time, this increase in price will spur new generation capacity to take advantage of the new opportunities for profit. In this case, the new generation could be attributed to a mix of sources, most likely natural gas- and coal-fired generation, which were discussed above. If significant excess supply existed in the United States, then it might be the case that no new generation would be brought on line to replace the lower supply. However, no such excess supply condition exists in the Eastern Grid of which Illinois is a part.

The regulatory system of Illinois complicates the notion of purchasing power. In a traditional, regulated utility environment, utilities managed all portions of the utility system from generation to transmission to distribution. In this environment, utilities would buy and sell power from other

utilities to make up for any shortfalls in demand or excess generation capacity. However, Illinois, like many other states, has altered the regulation of its electric utilities so that generation is decoupled from transmission and distribution. Generators sell power and energy as commodities. While Exelon holds both generation and distribution companies, these companies are not linked in the traditional fashion—Exelon generation can sell to any distributor, and Exelon distribution can purchase from any generator. Exelon's distribution arm will purchase the electricity that it needs from whatever source provides the cheapest energy; it already purchases all the energy that it supplies. Exelon's generating arm could purchase and then sell the electricity, but this would not change supply or demand; it would simply add a middle man in the electricity market.

For these reasons, the staff does not believe that purchasing power to make up for the generation at Dresden Units 2 and 3 is a meaningful alternative that requires independent analysis. Any impacts from purchasing power on the open market will follow those of the generation sources that end up supplying the power; and these impacts are covered in other sections from this chapter.

8.2.5 Other Alternatives

Other generation technologies considered by the NRC are discussed in the following subsections. The staff felt that none of these options alone was sufficient to replace the capacity and energy of Dresden Units 2 and 3. However, such alternatives might be used in combination, as discussed in Section 8.2.6.

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 through the year 2020 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. Increasing domestic concerns over oil security will only exacerbate the move away for oil-fired electricity generation. Therefore, the staff does not consider oil-fired generation by itself a feasible alternative to Dresden Units 2 and 3.

8.2.5.2 Wind Power

According to the DOE (2003), Illinois has a capacity of approximately 3000 MW(e) of class 4 wind sites. In general, class 4 sites can be useful for generating power with large wind turbines. In addition, Illinois also has 6000 MW(e) of class 3+ sites. Class 3+ sites might prove economically viable for wind power generation with near-term technological advances. Wind power plants typically run at capacity factors of 30 to 35 percent (Northwest Power Planning Council [NWPPC] 2000). These capacity factors are much lower than those for a nuclear power plant, which commonly run above 90 percent. Therefore, approximately 4200 to 4900 MW(e) would have to be developed to make up for the approximately 13 billion kWh(e) generated by Dresden Units 2 and 3 in 2001 (DOE/EIA 2003b). Because the largest commercially available wind turbines are in the range of 1 MW to 1.5 MW, approximately 2800 to 4900 of these turbines would be required to replace the generation from Dresden Units 2 and 3.

Although the wind resource in Illinois, in theory, is sufficient to support replacement of the capacity and energy from Dresden Units 2 and 3, many difficulties render full replacement a problematic option. For one, the vast bulk of the wind resource would have to be developed; and this development would be an enormously extensive undertaking, especially when one considers that total wind power capacity in the United States at the end of 2002 was approximately 4500 MW. Although wind power production in the United States is expected to grow many times over the coming decades, installation of approximately 4200 MW to 4900 MW in the Midwest to replace the generation from Dresden Units 2 and 3 would require approximately a near-term doubling of current U.S. wind generation capacity. Further, access to many of the best wind power sites would require easements, extensive road building and, potentially, extensive clearing (for towers and blades). Construction of thousands of wind turbines in Illinois would also require extensive construction of transmission lines to bring the power and the energy to market. Wind energy is an intermittent resource, whereas Dresden Units 2 and 3 provide constant baseload power. When there is little wind, wind energy would not compensate for the loss of Dresden Units 2 and 3 energy generation. For all these reasons, the staff concludes that wind power alone is not a feasible substitute at this time for the baseload generation from Dresden Units 2 and 3.

Wind power could be included in a combination of alternatives to replace Dresden Units 2 and 3. The environmental impacts of a large-scale wind farm are described in NUREG-1437, Section 8.3. The construction of roads, transmission lines, and turbine tower supports would result in short-term impacts, such as increases in erosion and sedimentation, and decreases in air quality from fugitive dust and equipment emissions. Construction in undeveloped areas

would have the potential to disturb and impact cultural resources or habitat for sensitive species. During operation, some land near wind turbines could be available for compatible uses, such as agriculture. The continuing aesthetic impact would be considerable, and there is a potential for bird collisions with turbine blades. Wind farms generate very little waste and pose no human health risk other than from occupational injuries. Although most impacts associated with a wind farm are SMALL or can be mitigated, some impacts such as the continuing aesthetic impact and impacts to sensitive habitats could be LARGE, depending on the location.

8.2.5.3 Solar Power

Solar technologies use the sun's energy and light to provide heat and cooling, light, hot water, and electricity for homes, businesses, and industry. Solar power technologies (both photovoltaic and thermal) cannot currently compete with conventional fossil-fueled technologies in grid-connected applications due to higher capital costs per kilowatt of capacity. The average capacity factor of photovoltaic cells is about 25 percent (NRC 1996), and the capacity factor for solar thermal systems is about 25 percent to 40 percent (NRC 1996). These capacity factors are low because solar power is an intermittent resource, providing power when the sun is strong, whereas Dresden Units 2 and 3 provide constant baseload power. Solar technologies simply cannot make up for the capacity from Dresden Units 2 and 3 when the sun is not shining.

There can be 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—140 km^2 (55 mi^2) per 1000 MW for photovoltaic and approximately 57 km^2 (22 mi^2) per 1000 MW for solar thermal systems (NRC 1996). Neither type of solar electric system would fit at the Dresden site, and both would have large environmental impacts at a greenfield site.

Currently available photovoltaic (PV) cell conversion efficiencies range from approximately 7 to 17 percent. The average solar energy falling on a horizontal surface in the Illinois region in June, a peak month for sunlight, is approximately 6.0 to 6.5 kWh/m^2 per day. If an average solar energy throughout the year of approximately 3 kWh/m^2 per day (Exelon 2003) and a conversion efficiency of 10 percent are assumed, PV cells would yield an annual electricity production of approximately 110 kWh(e)/m^2 per year in Illinois. At this assumed rate of generation, replacing the 13 billion kWh generated in 2001 by Dresden Units 2 and 3 (DOE/EIA 2003b) would require approximately 120 million m^2 or 120 km^2 (46 mi^2) of PV arrays. Because of the area's low rate of solar radiation, the high technology costs, and the intermittent nature of the resource, solar power is limited to niche applications and is not a feasible baseload alternative to license renewal of Dresden Units 2 and 3.

Solar power could, however, be included in a combination of alternatives to replace Dresden Units 2 and 3. The potential environmental impacts associated with a large-scale solar generation facility and transmission lines are described in NUREG-1437, Section 8.3. The construction impacts would be similar to those associated with a large wind farm as discussed in Section 8.2.5.2. The operating facility would also have considerable aesthetic impact. Solar installations pose no human health risk other than from occupational injuries. The manufacturing process for constructing a large amount of photovoltaic cells would result in waste generation, but this waste generation has not been quantified. Some impacts, such as impacts to sensitive areas, loss of productive land, and the continuing aesthetic impact, could be LARGE, depending on the location.

Installations of solar panels on residential and commercial rooftops are referred to as "distributed solar power." Based on an average house size of 139 m^2 (1500 ft^2) with a usable roof space of 70 m^2 (753 ft^2) and a higher conversion efficiency of 15 percent, over 1 million new or existing homes would have to be fitted with solar panels to replace the generation from Dresden Units 2 and 3. Without significant government or utility incentives, installation of distributed solar panels on this scale is unlikely. However, distributed solar power could be included in a combination of alternatives to replace Dresden. Distributed solar power would result in fewer construction-related impacts because solar panels would usually be placed on existing buildings, eliminating the need for land clearing or transmission lines. Aesthetic impacts would be only marginally greater than those already created by the existing or new buildings. Impacts from the manufacture of solar panels would still occur.

8.2.5.4 Hydropower

Less than 0.1 percent of Illinois electricity generating capacity and its electricity generation come from hydroelectric power (DOE/EIA 2003a). As stated in Section 8.3.4 of the GEIS, hydropower's percentage of the country's generating capacity is expected to decline because hydroelectric facilities have become difficult to site as a result of public concern over flooding, destruction of natural habitat, and alteration of natural river courses. According to the *U.S. Hydropower Resource Assessment for Illinois* (Idaho National Engineering and Environmental Laboratory 1997), there is only 301 MW of undeveloped hydroelectric capacity in Illinois, far below that required to replace the 1824 MW(e) of Dresden Units 2 and 3.

In the GEIS, the staff estimated that land requirements for hydroelectric power are approximately 400,000 ha (1 million ac or about 1600 mi^2) per 1000 MW. This requirement would need to be adjusted proportionally upwards to meet the requirements of Dresden Units 2 and 3. This would result in a large impact on land use, most of which would be out-of-state because of Illinois' limited hydroelectric potential. Furthermore, operation of a hydroelectric facility would alter aquatic habitats above and below the dam, and the alteration would impact

existing aquatic species. Due to the relatively low amount of undeveloped hydropower resource in Illinois and the large land-use and related environmental and ecological resource impacts associated with siting hydroelectric facilities large enough to replace Dresden Units 2 and 3, the staff concludes that local hydropower is not a feasible alternative to Dresden Units 2 and 3 OL renewal.

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 the 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 Dresden Units 2 and 3. The staff concludes geothermal energy is not a feasible alternative to renewal of the Dresden Units 2 and 3 OLs.

8.2.5.6 Wood Waste

A wood-burning facility can provide baseload power and operate with an average annual capacity factor of around 70 to 80 percent and with 20 to 25 percent efficiency (NRC 1996). The fuels required are variable and site-specific. A significant barrier to the use of wood waste to generate electricity is the high delivered fuel cost and the high construction cost per megawatt 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 megawatt 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 a smaller scale (NRC 1996). Like coal-fired plants, wood waste plants require large areas for fuel storage and processing and involve the same type of combustion equipment.

Due to uncertainties associated with obtaining sufficient wood and wood waste to fuel a 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 the use of wood waste is not a feasible alternative to renewing the Dresden Units 2 and 3 OLs.

8.2.5.7 Municipal Solid Waste

Municipal waste combustors incinerate the waste and use the resultant heat to generate steam, hot water, or electricity. The combustion process can reduce the volume of waste by up to 90 percent and the weight of the waste by up to 75 percent (EPA 2001). Municipal waste

combustors use three basic types of technologies: mass-burn, modular, and refuse-derived fuel (DOE/EIA 2001b). 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. Because of the need for specialized waste-separation and processing equipment for municipal solid waste, the initial capital costs for municipal solid-waste plants are greater than those for comparable steam turbine technology at wood waste facilities (NRC 1996).

Growth in the municipal waste combustion industry slowed dramatically during the 1990s after rapid growth during the 1980s. The slower growth was due to three primary factors: (1) the Tax Reform Act of 1986, which made capital intensive projects, such as municipal waste combustion facilities, more expensive relative to less capital intensive waste disposal alternatives, such as landfills; (2) the 1994 Supreme Court decision (*C&A Carbone, 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 may have had lower fees; and (3) increasingly stringent environmental regulations that increased the capital cost necessary to construct and maintain municipal waste combustion facilities (DOE/EIA 2001b).

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), much smaller than needed to replace the 1826-MW(e) baseload capacity of Dresden Units 2 and 3. Therefore, the staff concludes that municipal solid-waste combustion would not be a feasible alternative to renewal of the Dresden Units 2 and 3 OLs, particularly at the scale required.

8.2.5.8 Other Biomass-Derived Fuels

In addition to the use of wood waste and municipal solid-waste fuels, there are several other concepts for fueling electric generators, including burning crops, converting crops to a liquid fuel, such as ethanol, and gasifying crops (including wood waste). In the GEIS, the staff stated that none of these technologies has progressed to the point of being competitive on a large scale or of being reliable enough to replace a baseload plant such as Dresden Units 2 and 3 (NRC 1996). For these reasons, such fuels do not offer a feasible alternative to renewal of the Dresden Units 2 and 3 OLs.

8.2.5.9 Fuel Cells

Fuel cells work without combustion and its local 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 with 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. It can also be produced from electricity using electrolysis. Phosphoric acid fuel cells are the most mature fuel-cell technology, but they are only in the initial stages of commercialization. Phosphoric acid fuel cells are generally considered first-generation technology. These are commercially available today at a cost of approximately $4500 per kilowatt of installed capacity (DOE 2002). Higher-temperature, second-generation fuel cells achieve higher fuel-to-electricity and thermal efficiencies. The higher temperatures contribute to improved efficiencies and give the second-generation fuel cells the capability to generate steam for cogeneration and combined-cycle operations.

DOE had a performance target that in 2000 two second-generation fuel-cell technologies using molten carbonate and solid oxide technology, respectively, will be commercially available in sizes of approximately 3 MW at a cost of $1000 to $1500 per kilowatt of installed capacity (DOE 2002). For comparison, the installed capacity cost for a natural gas-fired, combined-cycle plant is on the order of $500 to $600 per kilowatt (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 2002); and natural gas, a potential feedstock for hydrogen, is less expensive than hydrogen. At the present time, however, the use of fuel cells is not economically or technologically competitive with other alternatives for baseload electricity generation. The use of fuels cells is, consequently, not a feasible alternative to renewal of the Dresden Units 2 and 3 OLs.

8.2.5.10 Delayed Retirement

Exelon has no plans for retiring any reactors in its fleet of nuclear plants and expects to need additional capacity in the near future (Exelon 2003). Further, Exelon indicates that any fossil plants slated for retirement tend to utilize less efficient generation and pollution control technologies. With more stringent environmental restrictions, the impact of delaying retirement of a fossil fuel plant to compensate for the loss of electricity from Dresden Units 2 and 3 would be bounded by the impacts for the natural gas- and coal-fired alternatives, and the impact would potentially be more severe because of the less efficient pollution control equipment from older plants. The staff, therefore, concluded that delayed retirement of other Exelon generating units could not provide a replacement of the power supplied by Dresden Units 2 and 3 and could not be a feasible alternative to Dresden Units 2 and 3 license renewal.

8.2.5.11 Utility-Sponsored Conservation

The utility-sponsored conservation alternative refers to a situation with the following three conditions: (1) Dresden Units 2 and 3 cease to operate; (2) no new generation is brought on line to meet the lost generation; and, (3) the lost generation is instead replaced by more efficient use of electricity. More efficient use would arise from utility-sponsored conservation programs, potentially including energy audits, incentives to install energy-efficient equipment, and informational programs to inform electricity consumers of the benefits of, and possibilities for, electricity conservation. There are two reasons to believe that conservation is not an appropriate alternative to the full energy and the capacity provided by Dresden Units 2 and 3.

The first reason is that the supply of cost-effective energy conservation measures, above and beyond what is already planned, may not be large enough to replace the energy and the capacity of Dresden Units 2 and 3. While it is possible, for example with large incentives, to decrease usage of electricity to meet the lost generation, it is the cost of such measures that ultimately matters. If the costs are high, for example, significantly higher than the costs of coal-fired or natural gas-fired generation or new nuclear generation, then it is infeasible to consider such measures as a replacement for Dresden Units 2 and 3. Hence, the feasibility of the utility-sponsored conservation alternative hinges largely on the costs of reducing demand, which will increase with the level of demand reduction. The cost of these measures has been under debate for many years. One estimate of utility demand-side management programs in 1992 gave an average cost of $0.040/kWh in 1992 dollars (Eto, et al. 1996), which is more than competitive with new generation. However, it has also been asserted that if such measures are this cost-effective, consumers would undertake them irrespective of utility programs. Therefore, such cost estimates must understate full consumer costs. Regardless, replacing the capacity and the energy from Dresden Units 2 and 3 would require a significant increase in the magnitude of energy conservation in the United States. According to the EIA (DOE/EIA 2001c), the sum of all large electric-utility energy conservation programs up through 2000 saved approximately 54,000 million kWh(e) in 2000. In 2001, Dresden Units 2 and 3 provided approximately 12,500 million kWh of electricity (DOE/EIA 2003b). Hence, to replace the lost generation at Dresden Units 2 and 3 would require an increase of over 25 percent in the total effect of large utility-sponsored conservation since the time that utilities have been reporting these numbers to the EIA. Such an increase would clearly increase the cost of energy conservation by moving beyond the more cost-effective measures.

The second reason that energy-conservation might not be an effective replacement for Dresden Units 2 and 3 involves the changing regulatory structure of the electric-utility industry. Even if it were cost-effective to replace the capacity from Dresden Units 2 and 3 using energy conservation, the regulatory structure in Illinois largely eliminates any incentive for Exelon to do so unilaterally. In a traditional, regulated utility environment, utilities managed all portions of the utility system from generation to transmission to distribution. In this environment, it was feasible

for utilities to invest in energy-efficiency programs because they could, in many states, receive reimbursement through changes in their electricity rates. However, Illinois, like many other states, has altered the regulation of its electric utilities so that generation is decoupled from transmission and distribution. Generators sell power and energy as if they were commodities. While Exelon holds both generation and distribution companies, these companies are not linked in the traditional fashion. Exelon's generating organization can sell to any distributor, and Exelon distribution can purchase from any generator. Generation companies will not be reimbursed for energy-efficient investments, making such investments infeasible from the perspective of the stockholders. Exelon's generating organization will not be able to offer competitively priced power if it subsidizes demand reduction alternatives. Any energy-efficiency investments would, therefore, need to come from other sources unassociated with Exelon, for example, State-sponsored energy-efficiency programs.

For the two reasons stated above—that the costs of electricity reduction may be too high to be cost effective in replacing Dresden Units 2 and 3 and that it is out of the purview of Exelon to bring about these reductions—the staff does not consider energy efficiency by itself as a feasible alternative to license renewal. However, conservation could be considered in combination with other alternatives to replace Dresden Units 2 and 3. Accordingly, the combination of alternatives discussed in Section 8.2.6 includes 300 MW(e) of energy conservation.

8.2.6 Combination of Alternatives

Should the OLs not be renewed, the lost generating capacity would be replaced by a combination of more than one (possibly many) alternative, discussed thus far. As discussed in Section 8.2, Dresden Units 2 and 3 have a combined net summer rating of 1826 MW(e).

There are many possible combinations of alternatives. Some alternatives could include renewable energy sources, such as wind or solar power. Table 8-8 contains a summary of the environmental impacts of an assumed combination of alternatives consisting of 1100 MW(e) of generation from a combined-cycle facility at the Dresden site, 300 MW(e) of energy conservation, and 429 MW(e) purchased from other generators. The impacts associated with the combined-cycle, natural gas-fired units are based on the gas-fired-generation impact assumptions discussed in Section 8.2.2, adjusted for the reduced generation capacity. While the demand-side management (DSM) measures would have few environmental impacts, operation of the new natural gas-fired plant would result in emissions and other environmental impacts. The environmental impacts associated with power purchased from other generators would still occur, but the impacts 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 unlikely that the

environmental impacts of any reasonable combination of generating and conservation options could be reduced to the level of impacts associated with the renewal of the OLs.

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

	Dresden Site		Alternate Site	
Impact Category	**Impact**	**Comments**	**Impact**	**Comments**
Land Use	SMALL to MODERATE	Almost 30 ha (75 ac) would be needed for power block, offices, roads, and parking areas. Additional impact would occur from construction of an underground gas pipeline.	SMALL to LARGE	Same as for Dresden site with addition of transmission lines.
Ecology	SMALL to MODERATE	Would use undeveloped areas at Dresden site. There would be potential for habitat loss and fragmentation and reduced productivity and biological diversity.	SMALL to MODERATE	Impact would depend on whether site is previously developed. Factors to consider include location and ecology of site and transmission-line route. There would be potential for habitat loss and fragmentation and reduced productivity and biological diversity.
Water Use and Quality	SMALL	Would use closed-cycle cooling system with natural gas combined-cycle units. This use would result in a significant reduction in cooling water requirements. Facility would continue limited groundwater use.	SMALL to MODERATE	Impact would depend on volume of water withdrawal, the constituents of the discharge water, the characteristics of surface water or groundwater source, and the new intake structures required.

Table 8-8. (contd)

	Dresden Site		Alternate Site	
Impact Category	**Impact**	**Comments**	**Impact**	**Comments**
Air Quality	MODERATE	Sulfur oxides: 81 MT/yr (89 tons/yr) Nitrogen oxides: 257 MT/yr (284 tons/yr)—Actual impact would depend on emissions offsets Carbon monoxide: 53 MT/yr (59 tons/yr) Particulates: 49 MT/yr (54 tons/yr) PM_{10} Other: CO_2 emissions contribute to global warming	MODERATE	Same emissions as Dresden site although offsets for NO_x would depend on location.
Waste	SMALL	Minimal waste product from fuel combination.	SMALL	Impacts identical to those for Dresden site.
Human Health	SMALL	Impacts considered minor.	SMALL	Impacts identical to those for Dresden site.

Table 8-8. (contd)

	Dresden Site		Alternate Site	
Impact Category	**Impact**	**Comments**	**Impact**	**Comments**
Socioeconomics	SMALL to MODERATE	During construction, impacts would be SMALL. Peak workforce during 2- to 3-year construction period would be significantly smaller than for other steam generation facilities.	SMALL to MODERATE	Construction impacts at alternate site would be similar to those at Dresden site but would depend on whether new site is located near a major metropolitan area.
		During operation, employment would be decreased from approximately 1000 permanent and contract workers to fewer than 100. All employment impacts would be tempered by proximity to the Chicago metropolitan area. Tax base would be preserved.		Minimal impacts on local tax base.
		Transportation impacts during operation would be SMALL due to the smaller workforce. Transportation impacts associated with construction workers would be SMALL to MODERATE.		Transportation impacts would be similar to those at Dresden site.

Table 8-8. (contd)

	Dresden Site		Alternate Site	
Impact Category	**Impact**	**Comments**	**Impact**	**Comments**
Aesthetics	MODERATE	MODERATE aesthetic impact due to impact of plant buildings and structures along with noise from plant operation.	MODERATE to LARGE	Impact would depend on location. Greatest impact likely would be from the new transmission line(s) that would be needed.
Historic and Archaeological Resources	SMALL to MODERATE	Studies would likely be needed to identify, evaluate, and address mitigation of the potential impacts of new plant construction on cultural resources.	SMALL to MODERATE	Alternate location would necessitate cultural studies to identify, evaluate, and address mitigation of the potential impacts of new plant construction on cultural resources at developed and undeveloped sites.
Environmental Justice	SMALL	No environmental pathways or locations were identified that would result in disproportionately high and adverse environmental impacts on minority and low-income populations. Impacts on minority and low-income communities would be similar to those experienced by the population as a whole. Any impacts would be tempered by proximity to the Chicago area.	SMALL to LARGE	Impacts would vary depending on population distribution and characteristics at new site. Impacts on Dresden site would be identical to those in the no-action alternative.

8.3 Summary of Alternatives Considered

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 in this chapter.

The no-action alternative would result in decommissioning Dresden Units 2 and 3 and would have SMALL environmental impacts for all impact categories with the exception of Socioeconomics. The no-action alternative is a conceptual alternative resulting in a net reduction in electricity generation; there will be no replacement power, and, therefore, no environmental impacts from replacement power. In actual practice, the power lost by not renewing the OLs for Dresden Units 2 and 3 would likely be replaced by (1) DSM and energy conservation, (2) electricity generated from other sources, either by Exelon or by another generator, or (3) some combination of these alternatives. Any replacement power would produce environmental impacts in addition to those discussed under the no-action alternative. Any replacement power would produce additional environmental impacts as discussed in Section 8.2.

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 air quality impacts from a coal-fired or natural gas-fired facility would be greater than the impacts of the continued operation of Dresden Units 2 and 3. The impacts of purchased power would still occur but would occur elsewhere, and the notion of purchased power is confused by changes in the electricity regulatory structure in Illinois. 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 the renewal of the OLs for Dresden Units 2 and 3.

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

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

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

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

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9.0 Summary and Conclusions

By letter dated January 3, 2003, Exelon Generation Company, LLC (Exelon) submitted an application to the U.S. Nuclear Regulatory Commission (NRC) to renew the operating licenses (OLs) for Dresden Units 2 and 3 for an additional 20-year period (Exelon 2003a). If the OLs are renewed, Illinois regulatory agencies and Exelon will ultimately decide whether the plant will continue to operate based on factors such as the need for power or other matters within the State's jurisdiction or the purview of the owners. If the operating licenses are renewed, the schedule is to issue the renewed licenses by July 2004. The renewed licenses would supercede the current licenses. The renewed licenses would expire on December 22, 2029, and January 12, 2031, 20 years after the original license expiration dates for Unit 2 and Unit 3, respectively. If the OLs are not renewed, the plant must be shut down at or before the expiration of the current OLs, which expire on December 22, 2009, for Unit 2, and January 12, 2011, for Unit 3.

Section 102 of the National Environmental Policy Act (NEPA) (42 USC 4321) requires an environmental impact statement (EIS) for major Federal actions that significantly affect the quality of the human environment. The NRC has issued regulations implementing Section 102 of NEPA in 10 CFR Part 51. Part 51 identifies licensing and regulatory actions that require an EIS. In 10 CFR 51.20(b)(2), the Commission requires preparation of an EIS or a supplement to an EIS for renewal of a reactor OL; 10 CFR 51.95(c) states that the EIS prepared at the OL renewal stage will be a supplement to the *Generic Environmental Impact Statement for License Renewal of Nuclear Plant*s (GEIS), NUREG-1437, Volumes 1 and 2 (NRC 1996, 1999).[(a)]

Upon acceptance of the Exelon application, the NRC began the environmental review process described in 10 CFR Part 51 by publishing a notice of intent to prepare an EIS and conduct scoping in the *Federal Register* (68 FR 12386-12387 [NRC 2003a]) on March 14, 2003. The staff visited the Dresden site in March 2003 and held public scoping meetings on April 10, 2003, in Morris, Illinois (NRC 2003b). The staff reviewed the Exelon Environmental Report (ER) (Exelon 2003b), compared it to the GEIS, consulted with other agencies, and conducted an independent review of the issues following the guidance set forth in NUREG-1555, Supplement 1, *The Standard Review Plans for Environmental Reviews for Nuclear Power Plants, Supplement 1: Operating License Renewal* (NRC 2000). The staff also considered the public comments received during the scoping process for preparation of the supplemental

(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.

environmental impact statement (SEIS) for Dresden Units 2 and 3. The public comments received during the scoping process that were considered to be within the scope of the environmental review are provided in Appendix A, Part I, of this SEIS.

The staff held two public meetings in Morris, Illinois in January 2004, to describe the preliminary results of the NRC environmental review and to answer questions to provide members of the public with information to assist them in formulating their comments. All the comments received on the draft SEIS were considered by the staff in developing this final SEIS and are presented in Appendix A, Part II.

This SEIS includes the NRC staff's analysis that considers and weighs the environmental effects of the proposed action, the environmental impacts of alternatives to the proposed action, and mitigation measures available for reducing or avoiding adverse effects. It also includes the staff's recommendation regarding the proposed action.

The NRC has adopted the following statement of purpose and need for license renewal from the GEIS:

> The purpose and need for the proposed action (renewal of an operating license) is to provide an option that allows for power generation capability beyond the term of a current nuclear power plant operating license to meet future system generating needs, as such needs may be determined by State, utility, and, where authorized, Federal (other than NRC) decisionmakers.

The evaluation criterion for the staff's environmental review, as stated in 10 CFR 51.95(c)(4) and the GEIS, is to determine

> . . . whether or not the adverse environmental impacts of license renewal are so great that preserving the option of license renewal for energy planning decisionmakers would be unreasonable.

Both the statement of purpose and need and the evaluation criterion implicitly acknowledge that there are factors, in addition to license renewal, that will ultimately determine whether an existing nuclear power plant continues to operate beyond the period of the current OL.

NRC regulations [10 CFR 51.95(c)(2)] contain the following statement regarding the content of SEISs prepared at the license renewal stage:

> The supplemental environmental impact statement for license renewal is not required to include discussion of need for power or the economic costs and economic benefits of the proposed action or of alternatives to the proposed action except insofar as such

benefits and costs are either essential for a determination regarding the inclusion of an alternative in the range of alternatives considered or relevant to mitigation. In addition, the supplemental environmental impact statement prepared at the license renewal stage need not discuss other issues not related to the environmental effects of the proposed action and the alternatives, or any aspect of the storage of spent fuel for the facility within the scope of the generic determination in § 51.23(a), "Temporary Storage of Spent Fuel after Cessation of Reactor Operations — Generic Determination of No Significant Environmental Impact," and in accordance with § 51.23(b).

The GEIS contains the results of a systematic evaluation of the consequences of renewing an OL and operating a nuclear power plant for an additional 20 years. The staff evaluated 92 environmental issues in the GEIS using the NRC's three-level standard of significance — SMALL, MODERATE, or LARGE — developed using the Council on Environmental Quality guidelines. The following definitions of the three significance levels are 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.

For 69 of the 92 issues considered in the GEIS, the staff analysis in the GEIS shows the following:

(1) The environmental impacts associated with the issue have been determined to apply either to all plants or, for some issues, to plants having a specific type of cooling system or other specified plant or site characteristic.

(2) A single significance level (i.e., SMALL, MODERATE, or LARGE) has been assigned to the impacts (except for collective off-site radiological impacts from the fuel cycle and from high-level waste [HLW] and spent fuel disposal).

(3) Mitigation of adverse impacts associated with the issue has been considered in the analysis, and it has been determined that additional plant-specific mitigation measures are likely not to be sufficiently beneficial to warrant implementation.

These 69 issues were identified in the GEIS as Category 1 issues. In the absence of new and significant information, the staff relied on conclusions as amplified by supporting information in the GEIS for issues designated Category 1 in Table B-1 of 10 CFR Part 51, Subpart A, Appendix B.

Of the 23 issues that do not meet the criteria set forth above, 21 are classified as Category 2 issues requiring analysis in a plant-specific supplement to the GEIS. The remaining two issues, environmental justice and chronic effects of electromagnetic fields, were not categorized. Environmental justice was not evaluated on a generic basis and must also be addressed in a plant-specific supplement to the GEIS. Information on the chronic effects of electromagnetic fields was not conclusive at the time the GEIS was prepared.

This SEIS documents the staff's consideration of all 92 environmental issues considered in the GEIS. The staff considered the environmental impacts associated with alternatives to license renewal and compared the environmental impacts of license renewal and the alternatives. The alternatives to license renewal that were considered include the no-action alternative (not renewing the OLs for Dresden Units 2 and 3) and alternative methods of power generation. These alternatives were evaluated assuming that the replacement power generation plant is located at the Dresden site or some other unspecified location in Illinois.

9.1 Environmental Impacts of the Proposed Action—License Renewal

Exelon and the staff have established independent processes for identifying and evaluating the significance of any new information on the environmental impacts of license renewal. Neither Exelon nor the staff has identified information that is both new and significant related to Category 1 issues that would call into question the conclusions in the GEIS. Similarly, neither public comments, Exelon, nor the staff has identified any new issue applicable to Dresden Units 2 and 3, that has a significant environmental impact. Therefore, the staff relies upon the conclusions of the GEIS for all Category 1 issues that are applicable to Dresden Units 2 and 3.

Exelon's license renewal application presents an analysis of the Category 2 issues that are applicable to Dresden Units 2 and 3, plus environmental justice and chronic effects from electromagnetic fields. The staff has reviewed the Exelon analysis for each issue and has conducted an independent review of each issue. Two Category 2 issues are not applicable because they are related to plant design features or site characteristics not found at Dresden. Four Category 2 issues are not discussed in this SEIS because they are specifically related to

refurbishment. Exelon has stated that its evaluation of structures and components, as required by 10 CFR 54.21, did not identify any major plant refurbishment activities or modifications as necessary to support the continued operation of Dresden Units 2 and 3 for the license renewal period (Exelon 2003b). In addition, any replacement of components or additional inspection activities are within the bounds of normal plant component replacement and, therefore, are not expected to affect the environment outside of the bounds of the plant operations evaluated in the *Final Environmental Statement Related to the Operation of Dresden Nuclear Power Station, Units 2 and 3* (AEC 1973).

Fifteen Category 2 issues related to operational impacts and postulated accidents during the renewal term, as well as environmental justice and chronic effects of electromagnetic fields, are discussed in detail in this SEIS. For all 15 Category 2 issues and environmental justice, the staff concludes that the potential environmental effects are of SMALL significance in the context of the standards set forth in the GEIS. In addition, the staff determined that appropriate Federal health agencies have not reached a consensus on the existence of chronic adverse effects from electromagnetic fields. Therefore, no further evaluation of this issue is required. For severe accident mitigation alternatives (SAMAs), the staff concludes that a reasonable, comprehensive effort was made to identify and evaluate SAMAs. Based on the staff's review of the SAMAs for Dresden Units 2 and 3, the staff concludes that two of the candidate SAMAs are potentially cost-beneficial. However, these SAMAs do not relate to adequately managing the effects of aging during the period of extended operation. Therefore, they do not need to be implemented as part of license renewal pursuant to 10 CFR Part 54.

Mitigation measures were considered for each Category 2 issue. Current measures to mitigate the environmental impacts of plant operation were found to be adequate, and no additional mitigation measures were deemed sufficiently beneficial in these issue areas to be warranted.

The following sections discuss unavoidable adverse impacts, irreversible or irretrievable commitments of resources, and the relationship between local short-term use of the environment and long-term productivity.

9.1.1 Unavoidable Adverse Impacts

An environmental review conducted at the license renewal stage differs from the review conducted in support of a construction permit because the plant is in existence at the license renewal stage and has operated for a number of years. As a result, adverse impacts associated with the initial construction have been avoided, have been mitigated, or have already occurred. The environmental impacts to be evaluated for license renewal are those associated with refurbishment and continued operation during the renewal term.

The adverse impacts of continued operation identified are considered to be of SMALL significance, and none of them warrants implementation of additional mitigation measures. The adverse impacts of likely alternatives if Dresden Units 2 and 3 cease operation at or before the expiration of the current OLS would not be smaller than those associated with continued operation of these units, and they may be greater for some impact categories in some locations.

9.1.2 Irreversible or Irretrievable Resource Commitments

The commitment of resources related to construction and operation of Dresden Units 2 and 3 during the current license period was made when the plants were built. The resource commitments to be considered in this SEIS are associated with continued operation of the plants for an additional 20 years. These resources include materials and equipment required for plant maintenance and operation, the nuclear fuel used by the reactors, and ultimately, permanent off-site storage space for the spent fuel assemblies.

The most significant resource commitments related to operation during the renewal term are related to fuel fabrication and the disposal of low- and high-level radioactive wastes. Dresden Units 2 and 3 replace approximately one-third of the fuel assemblies in each of the two units during every refueling outage, which occurs on a 24-month cycle.

The likely power generation alternatives if Dresden Units 2 and 3 cease operation on or before the expiration of the current OLs would require a commitment of resources for construction of the replacement plants as well as for fuel to run the plants.

9.1.3 Short-Term Use Versus Long-Term Productivity

An initial balance between short-term use and long-term productivity of the environment at the Dresden site was set when the plants were approved and construction began. That balance is now well established. Renewal of the OLs for Dresden Units 2 and 3 and continued operation of the plant will not alter the existing balance but may postpone the availability of the site for other uses. Denial of the application to renew the OLs would lead to shutdown of the plant and would alter the balance in a manner that depends on subsequent uses of the site. For example, the environmental consequences of turning the Dresden site into a park or an industrial facility are quite different.

9.2 Relative Significance of the Environmental Impacts of License Renewal and Alternatives

The proposed action is renewal of the OLs for Dresden Units 2 and 3. Chapter 2 describes the site, the plant, and interactions of the plant with the environment. As noted in Chapter 3, no refurbishment and no refurbishment impacts are expected at Dresden Units 2 and 3. Chapters 4 through 7 discuss environmental issues associated with renewal of the OLS. Environmental issues associated with the no-action alternative and alternatives involving power generation and use reduction are discussed in Chapter 8.

The significance of the environmental impacts from the proposed action (approval of the application for renewal of the OLs); the no-action alternative (denial of the application); alternatives involving alternate power generation by nuclear, coal, or gas generation of power at an unspecified alternate site; and a combination of alternatives are compared in Table 9-1. Use of a closed-cycle cooling system with cooling towers for alternate power generation is assumed for Table 9-1. Once-through cooling impacts would be smaller in some instances, (e.g., land use and ecology) and larger in others (e.g., ecology) because additional land is not required to support cooling towers and associated infrastructure.

Table 9-1 shows that the significance of the environmental effects of the proposed action are SMALL for all impact categories (except for collective off-site radiological impacts from the fuel cycle and from HLW and spent fuel disposal, for which a single significance level was not assigned [see Chapter 6]). The alternative actions, including the no-action alternative, may have environmental effects in at least some impact categories that reach MODERATE or LARGE significance.

9.3 Staff Conclusions and Recommendation

Based on (1) the analysis and findings in the GEIS (NRC 1996, 1999); (2) the ER submitted by Exelon (Exelon 2003b); (3) consultation with Federal, State, and local agencies; (4) the staff's own independent review; and (5) the staff's consideration of public comments, the recommendation of the staff is that the Commission determine that the adverse environmental impacts of license renewal for Dresden Units 2 and 3 are not so great that preserving the option of license renewal for energy planning decision makers would be unreasonable.

Table 9-1. Summary of Environmental Significance of License Renewal, the No-Action Alternative, and the Alternative Methods of Generation at an Unspecified Alternate Site Using a Closed-Cycle Cooling System

Impact Category	Proposed Action– License Renewal	No-Action Alternative– Denial of Renewal	Coal-Fired Generation	Natural-Gas-Fired Generation	New Nuclear Generation	Combination of Alternatives
Land Use	SMALL	SMALL	MODERATE to LARGE	SMALL to LARGE	MODERATE to LARGE	SMALL to LARGE
Ecology	SMALL	SMALL	MODERATE to LARGE	SMALL to LARGE	MODERATE to LARGE	SMALL to MODERATE
Water Use and Quality	SMALL	SMALL	SMALL to MODERATE	SMALL to MODERATE	SMALL to MODERATE	SMALL to MODERATE
Air Quality	SMALL	SMALL	MODERATE	MODERATE	SMALL	MODERATE
Waste	SMALL	SMALL	MODERATE	SMALL	SMALL	SMALL
Human Health[(a)]	SMALL	SMALL	SMALL	SMALL	SMALL	SMALL
Socioeconomics	SMALL	LARGE	SMALL to LARGE	SMALL to MODERATE	SMALL to LARGE	SMALL to MODERATE
Aesthetics	SMALL	SMALL	MODERATE to LARGE	MODERATE to LARGE	MODERATE to LARGE	MODERATE to LARGE
Historic and Archaeological Resources	SMALL	SMALL	SMALL to MODERATE	SMALL to MODERATE	SMALL to MODERATE	SMALL to MODERATE
Environmental Justice	SMALL	SMALL	SMALL to LARGE	SMALL to LARGE	SMALL to LARGE	SMALL to LARGE

(a) Excludes collective off-site radiological impacts from the fuel cycle and from HLW and spent fuel disposal, for which single significance levels were not assigned. See Chapter 6 for details.

9.4 References

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

10 CFR Part 54. Code of Federal Regulations, Title 10, *Energy*, Part 54, "Requirements for Renewal of Operating Licenses for Nuclear Power Plants."

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Exelon Generation Company (Exelon). 2003b. *Applicant's Environmental Report—Operating License Renewal Stage, Dresden Units 2 and 3*. Docket Nos. 50-237 and 50-249. Warrenville, Illinois.

National Environmental Policy Act of 1969, as amended (NEPA). 42 USC 4321, et seq.

U.S. Atomic Energy Commission (AEC). 1973. *Final Environmental Statement Related to the Operation of Dresden Nuclear Power Station, Units 2 and 3, Commonwealth Edison Company*, Docket No. 50-237 and 50-249, Washington, D.C.

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