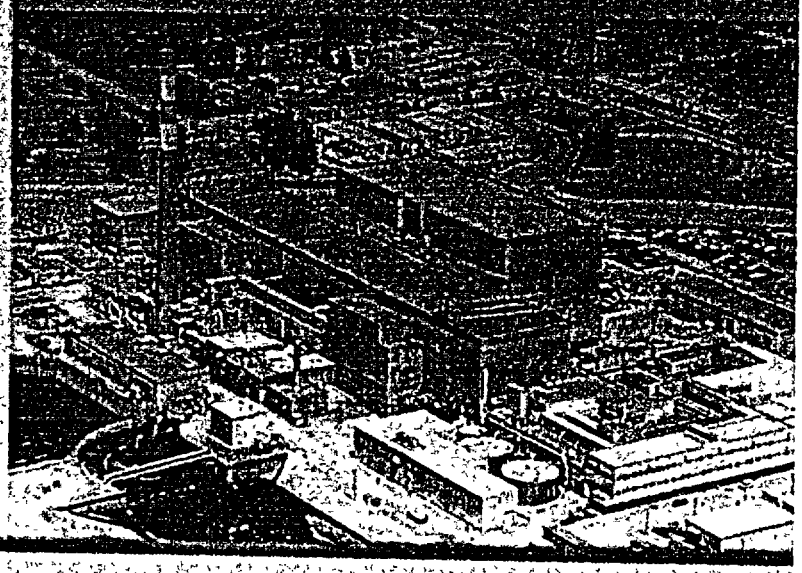
Applicant's Environmental Report
Operating License Renewal Stage
Quad Cities Nuclear Power Station
Units 1 and 2



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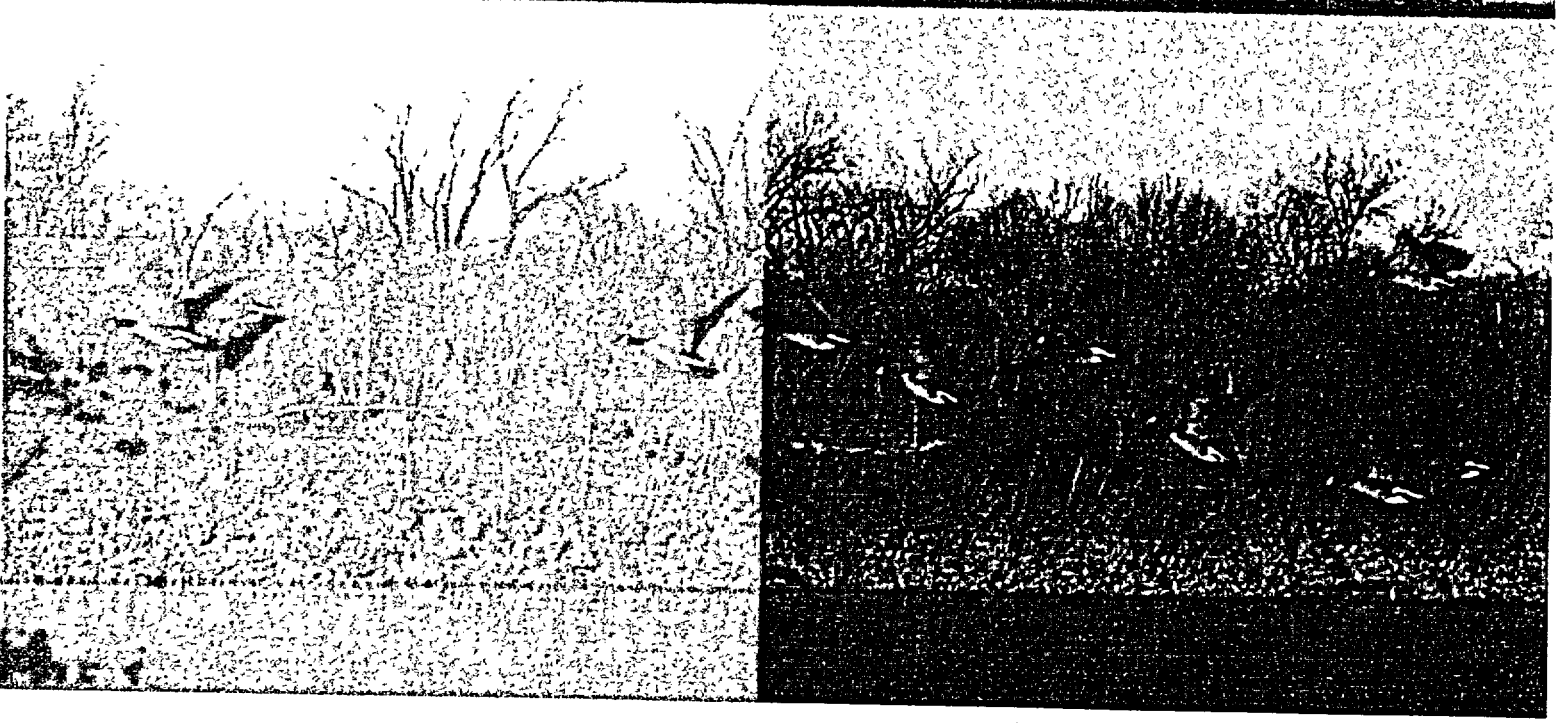

Appendix F

Applicant's Environmental Report – Operating License Renewal Stage Quad Cities Nuclear Power Station Units 1 and 2

Exelon Generation Company, LLC

License Nos. DPR-29 and DPR-30

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ACRONYMS AND ABBREVIATIONS

BWR	boiling water reactor
CEQ	Council on Environmental Quality
CFR	Code of Federal Regulations
cfs	cubic feet per second
ComEd	Commonwealth Edison
CWA	Clean Water Act
DSM	Demand-side management
EPA	U.S. Environmental Protection Agency
°F	degrees Fahrenheit
FES	Final Environmental Statement
FWS	U.S. Fish and Wildlife Service
GEIS	Generic Environmental Impact Statement for License Renewal of Nuclear Plants
gpm	gallons per minute
IPA	integrated plant assessment
kV	kilovolt
MW	megawatt
MWe	megawatts-electrical
NESC	National Electrical Safety Code
NMFS	National Marine Fisheries Service
NPDES	National Pollutant Discharge Elimination System
NRC	U.S. Nuclear Regulatory Commission
QCNPS	Quad Cities Nuclear Power Station
RM	River mile
SAMA	Severe Accident Mitigation Alternatives
SHPO	State Historic Preservation Officer
SMITTR	surveillance, monitoring, inspections, testing, trending, and recordkeeping

Chapter 1

Introduction

1.1 Purpose of and Need for Action

The U.S. Nuclear Regulatory Commission (NRC) licenses the operation of domestic nuclear power plants in accordance with the Atomic Energy Act of 1954, as amended, and NRC implementing regulations. Exelon Generation Company (EGC), LLC operates Quad Cities Nuclear Power Station Units 1 and 2 (QCNPS) pursuant to NRC Operating Licenses DPR-29 (Docket No. 50-254) and DPR-30 (Docket No. 50-265), respectively. Both licenses will expire December 14, 2012.

EGC has prepared this environmental report in conjunction with its application to NRC to renew the QCNPS Units 1 and 2 operating licenses, as provided by the following NRC regulations:

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

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

> "...The purpose and need for the proposed action (renewal of an operating license) is to provide an option that allows for power generation capability beyond the term of a current nuclear power plant operating license to meet future system generating needs, as such needs may be determined by State, utility, and, where authorized, Federal (other than NRC) decision makers...." (NRC 1996a)

The renewed operating licenses would allow for an additional 20 years of plant operation beyond the current QCNPS licensed operating period of 40 years.

1.2 Environmental Report Scope and Methodology

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

- NRC supplemental information in the *Federal Register* (NRC . 1996a; NRC 1996b; NRC 1996c; and NRC 1999a).
- *Generic Environmental Impact Statement for License Renewal of Nuclear Plants* (GEIS) (NRC 1996d and 1999b)
- *Regulatory Analysis for Amendments to Regulations for the Environmental Review for Renewal of Nuclear Power Plant Operating Licenses* (NRC 1996e)
- *Public Comments on the Proposed 10 CFR Part 51 Rule for Renewal of Nuclear Power Plant Operating Licenses and Supporting Documents: Review of Concerns and NRC Staff Response* (NRC 1996f)

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

1.3 Quad Cities Nuclear Power Station Licensee and Ownership

EGC is a subsidiary of Exelon Corporation. Exelon owns 75 percent of QCNPS and MidAmerican Energy Company (MidAmerican) owns the remaining 25 percent. EGC holds the NRC license to operate the plant, acting for itself and as agent for MidAmerican. Commonwealth Edison (ComEd), another Exelon Corporation subsidiary, owns and operates two of the five QCNPS transmission lines, Mid-American owns and operates two transmission lines, and Alliant Energy Corporation owns and operates one line.

EGC has ownership in 11, and operates 10, nuclear power plants in Illinois, Pennsylvania, and New Jersey. This includes three plants owned by AmerGen Energy Company, a joint venture with British Energy. Exelon Corporation was formed in 2000 by the merger of Unicom Corporation and PECO Energy Company. Prior to that time, ComEd, a Unicom subsidiary, operated QCNPS and owned it with MidAmerican. For this reason, the QCNPS license renewal environmental report makes frequent reference to ComEd and documentation that ComEd prepared.

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

Regulatory Requirement	Responsive Environmental Report Section(s)
10 CFR 51.53(c)(1)	Entire Document
10 CFR 51.53(c)(2), Sentences 1 and 2	3.0 Proposed Action
10 CFR 51.53(c)(2), Sentence 3	7.2.2 Environmental Impacts of Alternatives
10 CFR 51.53(c)(2) and 10 CFR 51.45(b)(1)	4.0 Environmental Consequences of the Proposed Action and Mitigating Actions
10 CFR 51.53(c)(2) and 10 CFR 51.45(b)(2)	6.3 Unavoidable Adverse Impacts
10 CFR 51.53(c)(2) and 10 CFR 51.45(b)(3)	7.0 Alternatives to the Proposed Action
	8.0 Comparison of Environmental Impacts of License Renewal with the Alternatives
10 CFR 51.53(c)(2) and 10 CFR 51.45(b)(4)	6.5 Short-Term Use Versus Long-Term Productivity of the Environment
10 CFR 51.53(c)(2) and 10 CFR 51.45(b)(5)	6.4 Irreversible or Irretrievable Resource Commitments
10 CFR 51.53(c)(2) and 10 CFR 51.45(c)	4.0 Environmental Consequences of the Proposed Action and Mitigating Actions
	6.2 Mitigation
	7.2.2 Environmental Impacts of Alternatives
	8.0 Comparison of Environmental Impact of License Renewal with the Alternatives
10 CFR 51.53(c)(2) and 10 CFR 51.45(d)	9.0 Status of Compliance
10 CFR 51.53(c)(2) and 10 CFR 51.45(e)	4.0 Environmental Consequences of the Proposed Action and Mitigating Actions
	6.3 Unavoidable Adverse Impacts
10 CFR 51.53(c)(3)(ii)(A)	4.1 Water Use Conflicts (Plants with Cooling Ponds or Cooling Towers Using Makeup Water from a Small River with Low Flow)
	4.6 Groundwater Use Conflicts (Plants Using Cooling Water Towers or Cooling Ponds that Withdraw Makeup Water from a Small River)
10 CFR 51.53(c)(3)(ii)(B)	4.2 Entrainment of Fish and Shellfish in Early Life Stages
	4.3 Impingement of Fish and Shellfish
	4.4 Heat Shock
10 CFR 51.53(c)(3)(ii)(C)	4.5 Groundwater Use Conflicts (Plants Using >100 gpm of Groundwater)
	4.7 Groundwater Use Conflicts (Plants Using Ranney Wells)

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

Regulatory Requirement	Responsive Environmental Report Section(s)	
10 CFR 51.53(c)(3)(ii)(D)	4.8	Degradation of Groundwater Quality
10 CFR 51.53(c)(3)(ii)(E)	4.9	Impacts of Refurbishment on Terrestrial Resources
	4.10	Threatened or Endangered Species
10 CFR 51.53(c)(3)(ii)(F)	4.11	Air Quality During Refurbishment (Non-Attainment and Maintenance Areas)
10 CFR 51.53(c)(3)(ii)(G)	4.12	Impact on Public Health of Microbiological Organisms
10 CFR 51.53(c)(3)(ii)(H)	4.13	Electromagnetic Fields – Acute Effects
10 CFR 51.53(c)(3)(ii)(I)	4.14	Housing Impacts
	4.15	Public Utilities: Public Water Supply Availability
	4.16	Education Impacts from Refurbishment
	4.17	Offsite Land Use
10 CFR 51.53(c)(3)(ii)(J)	4.18	Transportation
10 CFR 51.53(c)(3)(ii)(K)	4.19	Historic and Archaeological Resources
10 CFR 51.53(c)(3)(ii)(L)	4.20	Severe Accident Mitigation Alternatives
10 CFR 51.53(c)(3)(iii)	4.0	Environmental Consequences of the Proposed Action and Mitigating Actions
	6.2	Mitigation
10 CFR 51.53(c)(3)(iv)	5.0	Assessment of New and Significant Information
10 CFR 51, Appendix B, Table B-1, Footnote 6	2.6.2	Minority and Low-Income Populations

1.4 References

NRC (U.S. Nuclear Regulatory Commission), 1996a. "Environmental Review for Renewal of Nuclear Power Plant Operating Licenses," *Federal Register*, Vol. 61, No. 109, June 5.

NRC (U.S. Nuclear Regulatory Commission), 1996b. "Environmental Review for Renewal of Nuclear Power Plant Operating Licenses; Correction," *Federal Register*, Vol. 61, No. 147, July 30.

NRC (U.S. Nuclear Regulatory Commission), 1996c. "Environmental Review for Renewal of Nuclear Power Plant Operating Licenses," *Federal Register*, Vol. 61, No. 244, December 18.

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

NRC (U.S. Nuclear Regulatory Commission), 1996e. *Regulatory Analysis for Amendments to Regulations for the Environmental Review for Renewal of Nuclear Power Plant Operating Licenses*, NUREG-1440, Washington, DC, May.

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

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

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

Chapter 2

Site and Environmental Interfaces

2.1 Location and Features

As shown in Figure 2-1, QCNPS is located in Rock Island County, Illinois, on the east bank of Pool 14 of the Mississippi River, about 16 miles below Dam 13 and 13 miles from Dam 14. The station is approximately 506.5 miles upstream from its confluence with the Ohio River (i.e., river mile [RM] 506.5).

The Quad Cities metropolitan area, consisting of the Cities of Davenport and Bettendorf, Iowa, and Rock Island, Moline, and East Moline, Illinois, is located 20 miles southwest of QCNPS (Figure 2-1). QCNPS is about four miles north of Cordova, Illinois, and ten miles southwest of Clinton, Iowa (Figure 2-2).

The region within 6 miles of the site (Figure 2-2) includes portions of Rock Island and Whiteside Counties in Illinois and Scott and Clinton Counties in Iowa. The site is flat, with a grade level about nine feet above maximum flood stage. The area surrounding QCNPS is predominantly rural, consisting of farmland and woods; however, there is an industrial park approximately one mile north of the Station and a gas-fired power plant approximately one mile southeast of QCNPS. The lower segment of the Upper Mississippi River National Wildlife Refuge is across the river from QCNPS, providing habitat for numerous plant and animal species. The predominant land cover in this section of the refuge is woody terrestrial with a small portion characterized by wetland emergents (FWS 2000a).

The QCNPS site consists of 560 acres. In addition to the two nuclear reactors and their turbine buildings, intake and discharge canals, and ancillary buildings, the site includes switchyards and a retired spray canal now utilized to raise fish (Figure 2-3).

Section 3.1 describes key features of QCNPS.

2.2 Aquatic and Riparian Ecological Communities

2.2.1 HYDROLOGY

The Mississippi River is a large and productive ecosystem of national as well as global importance. The Upper Mississippi extends 1,366 miles from Lake Itasca, Minnesota, to its confluence with the Ohio River near Cairo, Illinois. The Upper Mississippi is divided by a series of dams into 28 navigational pools; QCNPS is located on Pool 14, midway between Lock and Dam 13 and Lock and Dam 14 (Figure 2-1).

At Camanche, Iowa, approximately six miles upstream of QCNPS, the Mississippi River has an annual mean flow of 48,750 cubic feet per second (cfs) (USGS 2000). Flows tend to be highest in spring and early summer (April - June), when the Upper Mississippi River basin receives snowmelt and runoff from spring rains, and lowest in winter (December - February) when precipitation in the region is lowest (USGS 2000). The mean annual flow ranges from 18,870 cfs to 94,690 cfs at the Camanche gaging station over the 1874-1999 period of record (USGS 2000). The Wapsipinicon River flows into the Mississippi from the west (Iowa), immediately upstream of QCNPS, contributing an additional 1,700 cfs (USGS 2000), so the actual flow at QCNPS averages around 50,500 cfs.

2.2.2 AQUATIC COMMUNITIES

EGC has monitored the aquatic communities of Pool 14 for more than 30 years. Pre-operational and operational studies of the lower trophic levels (phytoplankton, zooplankton, periphyton, and benthic invertebrates) were conducted from 1968 to 1977. Although subtle local effects associated with the operation of QCNPS (e.g., small increases in chlorophyll a concentrations immediately downstream of diffuser pipes) were apparent from these studies, populations of lower trophic level organisms in the vicinity of the Station were not adversely affected (ComEd 1981). Ichthyoplankton (fish eggs and larvae) investigations began in 1971 and were intensified from 1975 through 1985, after which they were discontinued (ComEd 1981; LMS 2000a). Eggs and larvae of freshwater drum, carp, and minnows were most often collected. Station operation, including open-cycle operation, has minimal effect on ichthyoplankton (ComEd 1981, LMS 2000a).

EGC and its contractors have monitored the fish populations of Pool 14 (the reach of the Mississippi River between Lock and Dam 13 and Lock and Dam 14) since 1971. A number of common species (gizzard shad, freshwater drum, emerald shiner, river shiner, bullhead minnow, carp, and bluegill) have consistently dominated fish collections. A number of other species, including mooneye, river carpsucker, smallmouth buffalo, shorthead and golden redhorse, channel and flathead catfish, white bass, largemouth bass, black crappie, sauger, and walleye have also been regularly collected.

The long-term monitoring program has not identified any impacts on the fishery of Pool 14 attributable to station operation (LMS 1995; LMS 2000b). Monitoring has demonstrated that the physical characteristics of the river (i.e., flow, temperature, and silt loads) are highly variable and subject to relatively rapid changes that do affect the Pool 14 fish community. As a consequence, individual fish species in Pool 14 have shown both short- and long-term fluctuations in abundance, but community composition has remained relatively stable (LMS 1995).

Two significant changes in the Pool 14 fishery (neither of which is associated with QCNPS operations) have been observed

since the early 1970s. First, the abundance of two popular gamefish, walleye and hybrid striped bass, has increased in the vicinity of the Station since 1985 as a result of a stocking program carried out by Southern Illinois University and EGC. These fish are reared in the Station's inactive cooling canal and released in the Mississippi River as fingerlings. The adult walleye population of Pool 14 is presently comprised of approximately 30 percent stocked fish (LaJeone and Monzingo 2000); increasing numbers of these canal-reared walleye are also appearing in downstream pools.

Second, the abundance of riverine fish species (e.g., freshwater drum, channel catfish, flathead catfish, and white bass) has generally increased in Pool 14, while the abundance of backwater fish species (e.g., white and black crappie) has generally decreased as sedimentation associated with operation of the navigation channel has degraded backwater areas and sloughs (LMS 2000b). Increases in channel catfish numbers are also believed to be related to changes in commercial fishing regulations that allow more fish to survive to adulthood and spawn (LaJeone and Monzingo 2000).

The Upper Mississippi River is home to one of the richest assemblages of freshwater pearly mussels (family Unionidae) in the world. In the late 19th and early 20th centuries, large numbers of freshwater mussels were harvested to make pearl buttons for clothing and, by 1912, nearly 200 button factories operated in Iowa and Illinois (Cummings and Mayer 1992). As a result, mussels were overharvested and populations of many species declined. The pearl button industry collapsed as plastic buttons came into widespread use in the 1940s, and mussel populations began to recover. In the 1950s, the Japanese found a new use for freshwater mussels: cultured pearls. Today, thousands of tons of mussel shells are harvested each year and exported to Japan to supply the cultured pearl industry.

Surveys conducted over the last several decades have documented dramatic declines in freshwater mussel populations across the United States. Among the factors thought to be responsible for the decline are overharvest, siltation of habitat (from agriculture, poor land management, and impoundments), competition from exotic species such as the zebra mussel, and pollution from agricultural and industrial chemicals. Of the 80 mussel species native to Illinois, more than half are currently threatened, endangered, extirpated, or extinct (Illinois Department of Natural Resources undated).

In 1999, Ecological Specialists, Inc, conducted a survey of freshwater mussels in Pool 14 of the Mississippi River as part of an assessment of the impacts of construction and operation of a 500-megawatt (MW) natural gas-fired, combined-cycle power plant on the federally-endangered Higgins' eye pearly mussel (*Lampsilis higginsi*). Survey sites were established at RM 507 (0.5 mile upstream of QCNPS) and at five sites downstream of QCNPS (RMs 505.7, 505.5, 504.5, 504.0, and 502.4) to determine the distribution and abundance of *Lampsilis higginsi* and other native mussel species.

Ecological specialists collected 31 unionid species from Pool 14 in May and June 1999, indicative of a diverse unionid community in this reach of the river. *Amblema p. plicata* (Threeridge; 37.9 percent of live mussels collected), *Quadrula p. pustulosa* (Pimpleback; 16.4 percent), and *Lampsilis cardium* (Plain pocketbook; 10.1 percent) were most abundant (Ecological Specialists, Inc. 1999). Other species commonly collected included *Fusconaia flava* (Wabash pigtoe; 6.2 percent), *Obliquaria reflexa* (Threehorn wartyback; 5.8 percent), *Quadrula quadrula* (Mapleleaf; 4.8 percent), and *Pyganodon grandis* (Giant floater; 4.5 percent). Each of these species is considered "widespread

and common" or "widespread and relatively common" throughout its range, which includes the Mississippi River and its tributaries (Cummings and Mayer 1992).

Other species were collected in small numbers. These included six mussel species listed by the States of Illinois and Iowa as threatened or endangered and a single federally-listed species, *Lampsilis higginsi*. Section 2.5 contains additional information on the status of *Lampsilis higginsi* in the Upper Mississippi River and Pool 14.

2.3 Groundwater Resources

QCNPS is located in the Meredosia Channel, an ancient channel of the Mississippi River. The Meredosia Channel has been filled over many thousands of years with unconsolidated sediments ranging in depth from approximately 50 to 300 feet (Blume 1966). Water for industrial and home use in the region comes from both wells and the Mississippi River.

Groundwater resources in the region are developed from three aquifer systems These consist of the alluvial aquifer, the shallow Silurian dolomite aquifer, and the artesian Cambrian-Ordovician aquifer. Some wells within a few miles of the Station pump at rates up to 700 gallons per minute (gpm). These are in the upper alluvial aquifer at depths of 20 to 100 feet below ground surface. (AEC 1972). Groundwater in the area is encountered at depths from approximately 17 to 21 feet. The groundwater gradient in this aquifer is relatively flat and generally flows to the Mississippi River, except during periods of high river flow (Blume 1966).

2.4 Critical and Important Terrestrial Habitats

Most of the western portion of the QCNPS site is industrial in character, containing the major generating facilities, switchyard, warehouses, parking lots, and roads. Open fields and areas of planted pines occupy most of the eastern portion of the QCNPS site. With the exception of an industrial park immediately north of the site and some forested bottomlands between the developed portion of the site and the Mississippi River, the surrounding lands are mostly agricultural, with large fields planted in grain (primarily corn) and forage crops.

Important terrestrial habitats include the nearby river islands and the area adjacent to the river on the Iowa side, which are included in the Upper Mississippi River National Wildlife and Fish Refuge (Figure 2-2). The Refuge was established in 1924 to protect bottomland habitat for migratory birds and fish, and extends 261 miles along the Mississippi River (FWS 2000b). Hundreds of thousands of waterfowl migrate through this portion of the Refuge each spring and fall. In addition, shorebirds and wading birds utilize the river shoreline and shallow backwaters. Many species of neotropical songbirds also migrate through this portion of the Mississippi River flyway during spring and fall (FWS 2000b).

In 1997, The American Bird Conservancy placed the Upper Mississippi River National Wildlife and Fish Refuge on its list of *Globally Important Bird Areas in the United States*. The honor is the highest level in the designation scheme of the American Bird Conservancy's United States Important Bird Areas program. It indicates the importance of the extensive wetland and floodplain forest complex which the Refuge provides for migratory waterfowl, songbirds, shorebirds, and resident species (FWS 2000b).

The Rock Creek transmission corridor crosses the Mississippi River and the Refuge approximately two miles north of the QCNPS site. The Davenport transmission corridor crosses the Mississippi River and the Refuge immediately south of the QCNPS site. The portion of the Refuge traversed by the Davenport corridor is within the Princeton Wildlife Management Area, which is managed by the Iowa Department of Natural Resources under a Cooperative Agreement with the Savanna District of the Refuge (FWS 2000b).

With the exception of the Upper Mississippi River National Wildlife and Fish Refuge, the QCNPS transmission lines traverse land-use categories such as row crops and pasture that are typical of eastern Iowa and northwestern Illinois. The QCNPS transmission lines do not cross any state or federal parks, or other wildlife refuges and wildlife management areas. No areas designated by the U.S. Fish and Wildlife Service (FWS) as "critical habitat" for threatened or endangered species exist at QCNPS or along the associated transmission corridors.

Exelon maintains its transmission corridors by trimming and mowing, and by the use of approved herbicides. Unless otherwise needed, vegetation management on the corridor follows a five-year cycle. The preferred method of vegetation management is 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.

Exelon participates in American Cyanamid's "Project Habitat". This program emphasizes management practices that are compatible with wildlife and improves habitat for various game and non-game species, as well as for rare species. The use of low-volume foliar herbicide application techniques creates and maintains native grass prairie habitats. Each year, Exelon converts areas of corridors to native prairie grass species.

MidAmerican Energy and Alliant Energy have similar right-of-way inspection and maintenance practices.

2.5 Threatened or Endangered Species

Terrestrial Species

EGC is not aware of any federally-listed endangered or threatened terrestrial species at the QCNPS site. However, relatively few threatened and endangered terrestrial species have been recorded in the counties crossed by the transmission corridors associated with QCNPS. Table 2-1 presents the federally listed threatened and endangered terrestrial species known to occur in Rock Island and Whiteside Counties, Illinois (FWS 1999a), and in Clinton and Scott Counties, Iowa (FWS 1999b) as well as any state-listed species reported by the states during EGC's consultation with state agencies.

The QCNPS transmission corridors are managed to prevent woody growth from reaching the transmission lines. The removal of woody species can provide outstanding grassland habitat for rare plant and animal species that depend on open conditions.

Aquatic Species

As discussed in Section 2.2, Pool 14 of the Upper Mississippi River harbors a diverse freshwater mussel community, including one federally-listed species, the Higgins' eye pearly mussel (*Lampsilis higginsi*). The draft Recovery Plan for this species provides reasonably up-to-date information on the distribution of *L. higginsi* in the Upper Mississippi River and its tributaries, as well as population estimates for selected locations (FWS 1998). The draft Recovery Plan also designates 10 sites as Essential Habitat Areas, including an area downstream of QCNPS near Cordova, Illinois, at RMs 505.5-503.0 (Figure 2-2). These Essential Habitat Areas were selected because reproducing populations of *L. higginsi* were known to be present (including adults of both sexes and juveniles), in association with a healthy and diverse ("diverse and dense") unionid community where more than 30 unionid species are believed to be present. The availability of historic data on a site was also a consideration because it allowed the Recovery Team to track trends in populations over the long term.

Lampsilis higginsi is typically found in association with other unionid species in large rivers. Favorable conditions include a stable substrate that is relatively silt-free, current velocities that are less than one meter/second during periods of low flow, and areas with unionid densities greater than 10 organisms/per square meter with at least 15 other species present (Ecological Specialists 1999). High unionid species richness in an area (assuming that suitable habitat is present) suggests a high probability of encountering *L. higginsi*; low unionid species richness in an area means a low probability of finding the species.

Current threats to *Lampsilis higginsi* include habitat alteration, water quality degradation, and zebra mussel infestation. Floodplain development, in-stream construction, and the commercial and recreational use of near-shore and floodplain areas (construction equipment and off-road vehicles) are thought to represent the most immediate threat to *L. higginsi* habitat in the Upper Mississippi River (Ecological Specialists 1999). Point and non-point source pollution are believed to have a less direct impact on the species, but are also a concern.

Lampsilis higginsi has historically been found in Pool 14 up- and downstream of QCNPS, with highest densities in the vicinity of Cordova, Illinois, some 1.5 to 3.5 miles downstream of the Station (Ecological Specialists 1999; LMS 2000a) (Figure 2-2). Based on surveys conducted by Ecological Specialists, Inc., in 1999, the area downstream of QCNPS (designated an Essential Habitat Area by FWS and located on the Illinois side of the river from RM

505.5 to 503.0) contains substantial numbers of freshwater mussels and small numbers of *L. higginsi* (Ecological Specialists 1999). At collection sites at RM 505.5, 504.5, and 504, a total of 12 specimens of *L. higginsi* were collected; reproduction was apparent because of the range of ages collected. A single specimen of *L. higginsi* was collected at a site farther downstream (RM 502.4).

2.6 Regional Demography

The *Generic Environmental Impact Statement for License Renewal of Nuclear Power Plants* (GEIS) presents a population characterization method that is based on two factors: "sparseness" and "proximity" (NRC 1996). "Sparseness" measures population density and city size within 20 miles of a site and categorizes the demographic information as follows:

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

Source: NRC 1996.

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

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

Source: NRC 1996.

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

EGC used 2000 census data from the U.S. Census Bureau website (USCB 2000a) and geographic information system software (Environmental Systems Research Institute's ArcView®) to determine demographic characteristics in the QCNPS vicinity. The Census Bureau provides updated annual projections, in addition to decennial data, for selected portions of its demographic information. However, Section 2.6.2 (Minority and Low-Income Populations) of this environmental report uses 1990 low-income population demographic information, because updated projections are not available.

GEIS Sparseness and Proximity Matrix

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

Low Population Area — Medium Population Area — High Population Area

Source: NRC 1996.

2.6.1 GENERAL POPULATION

EGC used the Arcview® geographic information system software to combine Census Bureau block group data with the Environmental Systems Research Institute, Inc. spatial data to determine 20- and 50-mile radius populations on a block group basis. In the event that a block group fell partially within the radius, an average population density for the entire block group was calculated. Then, the average density was multiplied by the percentage of the block group's physical land area that fell within the radius to produce an estimated number of persons located within the radius.

As derived from Census Bureau information, 281,423 people live within 20 miles of QCNPS. Applying the GEIS sparseness measures, QCNPS has a population density of 224 persons per square mile within 20 miles and falls into the "least sparse" category, Category 4 (having greater than or equal to 120 persons per square mile within 20 miles).

As estimated from Census Bureau information, 656,527 people live within 50 miles of QCNPS. This equates to a population density of 83 persons per square mile within 50 miles. The largest city within 50-miles of QCNPS is Davenport, Iowa, with a population of 98,359. Applying the GEIS

proximity measures, QCNPS is classified as Category 2 (no city with 100,000 or more persons and between 50 and 190 persons per square mile within 50 miles). According to the GEIS sparseness and proximity matrix, the QCNPS ranks of sparseness Category 4 and proximity Category 2 result in the conclusion that QCNPS is located in a Medium Population Area.

All or parts of 21 counties (Figure 2-1) and the Cities of Davenport (Iowa) and Rock Island, Moline, and East Moline (Illinois) are located within 50 miles of QCNPS. Approximately 77 percent of QCNPS' employees live in three Counties: Rock Island, Whiteside, and Scott. Of these, 53.5 percent live in Rock Island and Whiteside Counties and 23.5 percent live in Scott County. The remaining 23 percent of the employees reside in 16 other counties with concentrations ranging from 1 to 74 employees per county.

Rock Island and Whiteside Counties are located in western Illinois and Scott County is in eastern Iowa. All three flank the Mississippi River and are approximately 165 miles west of Chicago. The combined populations of the three counties in 2000 exceeded 368,000 (USCB 2000c). Rock Island County, Illinois, and Scott County, Iowa, are contained in the Quad Cities metropolitan area, which includes the Cities of Davenport and Bettendorf, Iowa, and Rock Island, Moline, and East Moline, Illinois. Whiteside County is predominately rural, with over 67 percent of the land area in crops (Illinois Department of Natural Resources 1996). Both Whiteside and Rock Island Counties are growing at slower rates than Illinois as a whole. From 1990 to 2000, Illinois' average annual population growth rate was 0.9 percent, while the populations of Whiteside and Rock Island Counties increased by 0.08 and 0.04 percent, respectively (USCB 1995a and 2000c). Scott County's population increased between 1990 and 2000 at the rate of 0.5 percent compared with the Iowa average annual growth rate of 0.5 percent (USCB 1995a and 2000c).

In 1995, Illinois' population of 11.8 million people represented 4.5 percent of the nation's population, ranking 6th in population among the 50 states and the District of Columbia (USCB 1996a). By the year 2030, Illinois' population is projected to be 13.5 million people, growing at an average annual rate of 0.3 percent (TtNUS 2001). By the year 2030, Rock Island and Whiteside Counties are each projected to decrease at average annual rates of 0.2 percent (TtNUS 2001).

Iowa had a population of 2.8 million people in 1995, or 1.1 percent of the nation's population. This placed Iowa as the 30th most populous state among the 50 states and the District of Columbia (USCB 1996b). By 2030, Iowa's population is projected to be 3 million people with an average annual growth rate of 0.1 percent (TtNUS 2001). Between the years 2000 and 2030, Scott County's population is expected to increase to 179,740, reflecting an average annual growth rate of 0.4 percent (TtNUS 2001).

Table 2-2 shows estimated populations and annual growth rates for the three counties with the greatest potential to be socio-economically affected by license renewal activities at QCNPS. Figures 2-1 and 2-2 show the locations of these areas.

2.6.2 MINORITY AND LOW-INCOME POPULATIONS

Background

The NRC performed environmental justice analyses for Arkansas Nuclear One, Unit 1, and Edwin I. Hatch Nuclear Plant, Units 1 and 2, during the development of the Supplemental Environmental Impact Statement (NRC 2000a and NRC 2000b). In so doing, NRC used a 50-mile radius as the overall area that would contain environmental impact sites and the state as the geographic area for comparative

analysis. EGC has adopted this approach for identifying the QCNPS minority and low-income populations that could be affected by QCNPS operations.

EGC used ArcView® geographic information system software to combine Census Bureau TIGER line data with census data to determine the minority characteristics on a block group level. Because Census Bureau 2000 low-income census data are not available, EGC used 1990 data for its low-income analysis. EGC used 2000 data for minority populations. EGC included all block groups or tracts if any of their area lay within 50 miles of QCNPS. The 50-mile radius includes 637 block groups and 189 tracts. EGC defines the geographic area for QCNPS as the entire states of Illinois or Iowa separately for block groups or tracts that are contained in each state.

Minority Populations

The NRC Procedural Guidance for Preparing Environmental Assessments and Considering Environmental Issues defines, a "minority" population as: American Indian or Alaskan Native; Asian; Native Hawaiian or other Pacific Islander; or Black races; other; multi-racial; or the aggregate of all minority races; or Hispanic ethnicity (NRC 2001). The guidance indicates that a minority population exists if either of the following two conditions exists:

1. The minority population of the census block or environmental impact site exceeds 50 percent, or

2. The minority population percentage of the environmental impact area is significantly greater (typically at least 20 points) than the minority population percentage in the geographic area chosen for comparative analysis.

The NRC guidance calls for use of the most recent Census Bureau decennial census data. EGC used 2000 census data from the Census Bureau website (USCB 2000c) in determining the percentage of the total population within Illinois and Iowa for each minority category, and in identifying minority populations within 50 miles of QCNPS.

EGC divided Census Bureau population numbers for each minority population within each block group by the total population for that block group to obtain the percent of the block group's population represented by each minority. For each of the 637 block groups within 50 miles of QCNPS, EGC calculated the percent of the population in each minority category and compared the result to the corresponding geographic area's minority threshold percentages to determine whether minority populations exist. EGC defines the geographic area for QCNPS as the entire State of Illinois when the block group is contained within Illinois, and all of Iowa when the block group is contained within Iowa. Census Bureau data (USCB 2000c) for Illinois characterizes 0.25 percent as American Indian or Alaskan Native; 3.41 percent Asian; 0.04 percent Native Hawaiian or other Pacific Islander; 15.11 percent Black races; 5.82 percent all other single minorities; 0.19 percent multi-racial; 24.82 percent aggregate of minority races; and 12.32 percent Hispanic ethnicity. Census Bureau data (USCB 2000c) for Iowa characterizes 0.31 percent as American Indian or Alaskan Native; 1.25 percent Asian; 0.00 percent Native Hawaiian or other Pacific Islander; 2.11 percent Black races; 1.28 percent all other single minorities; 1.09 percent multi-racial; 6.07 percent aggregate of minority races; and 2.82 percent Hispanic ethnicity.

Based on the "more than 20 percent" or the "exceeds 50 percent" criteria, no American Indian or Alaskan Native, Asian, Native Hawaiian or other Pacific Islander and no Multi-racial minorities exist in the geographic area. Table 2-3 presents the numbers of block groups within each county that exceed the threshold for determining the presence of minority populations.

Based on the "more than 20 percent" criterion, the Black Races minority populations exist in 23 block groups (Table 2-3). Figure 2-4 displays the locations of these minority block groups, while Table 2-3 displays the minority block group distributions among the counties in the geographic area.

Based on the "more than 20 percent" criterion, the All Other Single Minorities, minority populations exist in three block groups (Table 2-3). Figure 2-5 displays the minority block group distributions among the counties in the geographic area.

Based on the "exceeds 50 percent" criterion, the Aggregate of Minority Races populations exist in 33 block groups (Table 2-3). Figure 2-6 displays the locations of these block groups, while Table 2-3 displays the minority block group distributions among the counties in the geographic area.

Based on the "more than 20 percent" criterion, the Hispanic Ethnicity minority populations exist in 12 block groups (Table 2-3). Figure 2-7 displays the minority block group distributions among the counties in the geographic area.

Low-Income Populations

NRC guidance defines "low-income" using Census Bureau statistical poverty thresholds (NRC 2001). EGC divided Census Bureau "low-income" household numbers for each census tract by the total households for that tract to obtain the percentage of "low-income" households per tract. Census Bureau data (USCB 1990) characterize 11.47 percent of Illinois households as low-income while 11.93 percent of Iowa households are classified as low-income households. A "low-income population" is considered to be present if:

1. The low-income population of the census block or environmental impact site exceeds 50 percent, or

2. The percentage of households below the poverty level in an environmental impact area is significantly greater (typically at least 20 points) than the low-income population percentage in the geographic area chosen for comparative analysis.

Based on the "more than 20 percent" criterion, one census tract contains a low-income population. Table 2-3 displays the low-income household tract distributions among the counties in the geographic area while Figure 2-8 displays the location of this low-income tract in Rock Island, Illinois.

2.7 Economic Base

QCNPS is located in Rock Island County, Illinois, which lies along the Mississippi River, approximately 165 miles west of Chicago. Rock Island County is a part of the Davenport-Moline-Rock Island, Iowa-Illinois Metropolitan Statistical Area which also includes East Moline, Illinois and Bettendorf, Iowa. The 2000 census population of the Metropolitan Statistical Area is 359,062 and ranks 116th in the nation for population size (USCB 2000b).

Today, the Metropolitan Statistical Area has a transportation network of trucking and rail terminals, interstate highway access to east-west and north-south routes, one international and a number of regional airports, and access to international seaports via the Mississippi River, giving the area access to both domestic and international markets (Rock Island County 1998).

With the recession of the 1980s and the farm crisis that ensued, the region's labor force declined by 1.1 percent (Rock Island County 1998). The recession affected not only the agricultural sector, but also the smokestack industries that relied upon the farm business. While the area is still recovering from these events, a shift has taken place from an economy that was heavily reliant on agriculture to one centered on service provision (Rock Island County 1998). One of the newer and rapidly growing industries in the County is riverboat gambling.

The nonprofessional services sector realized a 121.1 percent increase in employment between 1980 and 1996. During that same period, manufacturing employment declined by 41 percent, durable goods production by 54.4 percent, and non-electrical machine production by 63.3 percent (Rock Island County 1998). For Rock Island County, the 1997 leading economic employment sectors and respective rankings were as follows: services (32 percent), retail trade (22 per-cent), and manufacturing (20 percent) (USCB 1997).

For Scott County, Iowa, the leading sectors were: services (34 percent), retail trade (24 percent), and manufacturing (19 per-cent) (USCB 1997).

And, for Whiteside County, Illinois, the 1997 leading sectors were: manufacturing (36 per-cent), services (28 percent), and retail trade (20 percent) (USCB 1997).

Leading employers for the Quad City Area include: John Deere, the Rock Island Arsenal, Genesis Medical Center, Alcoa, IBP, Trinity Medical Center, Oscar Mayer, Case IH Corporation, MidAmerican Energy Company, Minnesota Mining and Manufacturing Company (3M), Ralston Purina, and Sivyer Steel Company (Bi-State Regional Commission 1999).

The annualized unemployment rate for the State of Illinois for 1999 was 4.3 percent. In comparison, Rock Island and Whiteside Counties had 1999 unemployment rates of 5.6 and 4.4 percent, respectively (Illinois Department of Employment Security 2000). For the State of Iowa, the annualized unemployment rate for 1999 was 2.5 per-cent. Scott County's 1999 unemployment rate was 2.6 percent (Iowa Workforce Development 2000).

2.8 Taxes

In the State of Illinois, each county is divided into smaller taxing districts, and property tax collections and distributions are funneled through these districts. Every year, each district examines fiscal needs for the following year and extends a levy to the county in an amount that would cover proposed budgets. The county then issues property tax assessments and bills based on (1) individual district budget needs and (2) the characteristics of the properties residing within those districts. Once the tax revenues are collected, the county redistributes the revenues to the districts which, in turn, fulfill budget obligations for the oncoming fiscal year. (Note: the amounts of revenues distributed to the districts by the county may not be identical to the amount collected. Items such as court-ordered refunds or abatements may absorb a portion of the revenues before they are redistributed).

QCNPS pays annual property taxes to Rock Island County. Taxes fund Rock Island County operations, including the school system, fire districts, libraries, road maintenance, municipalities, and sanitary districts (Alberts 2001). For the years 1997 to 2000, QCNPS's property taxes provided approximately 2.7 percent of Rock Island County's total levee extension and approximately 2.8 percent of Rock Island County's total collections available for distribution. Table 2-4 compares QCNPS' tax payments to Rock Island County levee extensions and collections available for distribution.

EGC projects that QCNPS' annual property taxes will not remain constant throughout the license renewal period. In 1997, the State of Illinois deregulated the utility industry which, in turn, changed the methods of plant value assessment. EGC is in the process of re-evaluating the utilities' tax payments to Rock Island County. Before deregulation, utility tax payments were derived by using depreciated book value assessments. Since deregulation, payments are derived by using fair market value assessments. Because fair market values are influenced by economic conditions and market forces, current fair market values are somewhat below depreciated book values. Therefore, County property tax revenues should be lower than in the past. EGC is appealing the current assessment and plans to negotiate a graduated reduction in payments to minimize the financial disruption to the districts caused by a sudden revenue cut.

2.9 Land Use Planning

This section focuses on Whiteside, Rock Island, and Scott Counties because the majority (approximately 77 percent) of the permanent QCNPS workforce lives in these counties (see Section 3.4) and because EGC pays the majority of its property taxes to Rock Island County. All three counties have experienced population shifts over the last several decades and their comprehensive land use plans reflect planning efforts and public involvement in the planning process, to date. Land use planning tools, such as zoning, guide growth and development. All plans share the goals of encouraging growth and development in areas where public facilities (such as water and sewer systems) are planned and discouraging strip development. As demonstrated below, land use plans for the three counties guide development but do not contain growth control measures that limit housing development (Daniels et al. 1995).

Rock Island County, Illinois

Rock Island County occupies 452 square miles, or 289,331 square acres of land/water area. Current land use categories and rates are as follows: cropland (37.3 percent), grassland (30.2 percent), forest/woodland (12.6 percent), wetland (4.6 percent), urban/built-up (8.1 percent), open water (7.0 percent), and barren/exposed land (0.2 percent) (Illinois Department of Natural Resources 1996).

Rock Island County utilizes four major tools in an effort to manage current and future land use: the 1998 Land Use Plan, the Zoning Ordinance, the Land Evaluation and Assessment Program, and Subdivision Regulations. All four tools promote the idea that land planned for residential/commercial/industrial growth will be identified within existing communities and will have access to existing or planned infrastructures. The idea is to manage growth and sprawl throughout the County (Rock Island County 1998).

The three major municipalities in Rock Island County (Moline, East Moline, and Rock Island) are landlocked between the Mississippi River and Iowa to the north and the Rock River to the south. These cities must consider crossing the Rock River to enlarge their incorporated boundaries. Development trends in the last several years have shown that commercial development has primarily taken place in the unincorporated communities, while residential growth has occurred in rural areas (Rock Island County 1998).

Since the 1970s, Rock Island County has experienced a significant decline in population. The 10.4 percent population decline experienced between 1980 and 1990 was directly related to the faltering economy of the region. Rock Island County is recovering from an economic downturn that occurred in the agriculture industry. The farm crisis of the 1980s affected not only the agriculture industry, but also the smokestack industries that relied on farm business. The numerous vacant industrial sites along the river are evidence of the change that has taken place in the area's economy. As a result, there's been a shift in dependence from heavy industry and manufacturing to non-professional service provision and retail trade. However, there is recognition that the service provision and retail trade sectors will not provide a strong enough base for planned economic growth. Consequently, younger adult population groups are leaving the area. Because of this trend, the accommodation of population growth, through housing, infrastructure, and public services, has not been a concern. The majority of new residential construction is in rural areas and is related to an increase in urban crime and the declining integrity of the existing housing and infrastructure. Urban neighborhoods are aged and the associated property values continue to drop. The County is attempting, through the use of a solid comprehensive

land use plan, to guide growth so as to not diminish the County's valuable agricultural and natural land (Rock Island County 1998).

Within its boundaries, Rock Island County has a total of 143,573 acres of prime farmland and an additional 42,895 acres are considered to be of statewide agricultural importance. Two of the three largest employers in the County are agriculture-related and the agriculture of Rock Island County is consistent with the statewide role of agriculture. Illinois ranks second in the nation in total cash crop receipts and, because agriculture is of such importance, the County has established a Land Evaluation and Site Assessment program. It is a tool designed to generally prevent prime agricultural land from conversion. History has shown a nationwide reduction in farmland. This trend is accompanied by an increase in farm size, a reduction in the numbers of farms, and the shift from family farming to agri-business (Rock Island County 1998).

Scott County, Iowa

Scott County is a combination of flat and gently rolling farmland edged by wooded bluffs and river bottomland. The County occupies 465 square miles or 297,600 square acres of land/water area. Current unincorporated land use categories and rates are as follows: agricultural land (83 percent), forests (7 percent), farmsteads (less than 1 percent), residential (3 percent), commercial/industrial (less than 1 percent), public facilities (less than 1 percent), transportation (4 percent), and parks/public open space (2 percent) (Scott County 1994). Nearly 90 percent of all unincorporated land in Scott County is in cultivation, pasture, or forest (Scott County 1994).

Scott County also utilizes three major tools in effort to manage current and future land use: the Land Use Plan and updates, the Zoning Ordinance, and the Subdivision Ordinance. All three tools promote the idea that land planned for residential/commercial/industrial growth will be identified within existing communities and have access to existing or planned infrastructures. The idea is to manage growth throughout the County while protecting and conserving prime agricultural land. Scott County has also seen a trend in the number and size of farms that reflects the statewide trend toward fewer and larger farms (Scott County 1994).

As an integral part of the Iowa-Illinois Metropolitan Statistical Area, Scott County has been impacted by the 1980s agricultural industry decline. As a result, the population has dwindled and the manufacturing industry has been sizably impacted. Since then, residential and commercial development has shown a small recovery. Of the relatively small numbers of new homes that have been constructed, 80 percent have been built in existing subdivisions. Public services have, therefore, been able to meet current development needs. The land use plan indicates that infrastructure will be constructed/adapted to accommodate future growth needs, should current trends change (Scott County 1994).

Whiteside County, Illinois

Whiteside County occupies 698 square miles or 446,744 square acres of land/water area. Current land use categories and rates are as follows: cropland (67.8 percent), grassland (20.6 percent), forest/woodland (4.3 percent), wetland (2.0 percent), urban/built-up (2.1 percent), open water (3.1 percent), and barren/exposed land (less than 0.1 percent) (Illinois Department of Natural Resources 1996).

Whiteside County does not have a current comprehensive land use plan. The County does use zoning ordinances and subdivision regulations to provide the "standards necessary to ensure orderly growth in the unincorporated areas of the county, a growth that will allow for agricultural,

residential, commercial, recreational, and industrial uses that do not conflict with one another" (Whiteside County 2000).

2.10 Social Services and Public Facilities

2.10.1 PUBLIC WATER SUPPLY

QCNPS pumps groundwater for use as potable water and is not connected to a municipal system. Because 77 percent of the permanent employees of QCNPS reside in Rock Island and Whiteside Counties (Illinois) and Scott County (Iowa), discussion of public water supply systems will focus on these three areas.

At the present time, the water supply systems in Rock Island, Scott, and Whiteside Counties are operating below their maximum capacities. This level of operation demonstrates that each community could absorb new employees without jeopardizing its water supplies. Tables 2-5 to 2-7 identify major water suppliers (those providing at least 100,000 gallons per day) in Rock Island and Whiteside Counties in Illinois and Scott County, Iowa, respectively.

2.10.2 TRANSPORTATION

Road access to QCNPS is via Illinois State Route 84, a two-lane paved road. Route 84 intersects with Interstate 80 approximately 14 miles south of the Station (see Figures 2-1 and 2-2). Route 84 has a north-south orientation and is used by employees traveling from the Rock Island, Whiteside, and Scott County areas. Scott County employees travel across the Interstate 80 bridge and north with the Rock Island County traffic on Route 84. Employees coming from Whiteside County travel south on Route 84 to reach the Station. Traffic count data for each of these highways/roads is displayed in Table 2-8 (Wild 2001). The State of Illinois does not make Level of Service determinations in rural, non-metropolitan areas such as at QCNPS unless it is deemed necessary. None of the roads listed in Table 2-8 has had Level of Service determinations calculated by the Illinois Department of Transportation (Bankson 2001).

2.11 Air Quality

QCNPS is located in Rock Island County, Illinois, which is part of the Metropolitan Quad Cities Interstate Air Quality Control Region. All counties in this Air Quality Control Region are designated as being in attainment for all criteria pollutants (40 CFR 81.102, 40 CFR 81.314 and 40 CFR 81.316).

All counties in Illinois within 50 miles of QCNPS are designated as being in attainment for all criteria pollutants, as are all counties in Iowa (40 CFR 81.314 and 40 CFR 81.316).

2.12 Historic and Archaeological Resources

Area History in Brief

Historic records indicate that, from 10,000 to 8,000 BC, the northern Illinois region was inhabited by Paleo Indians who briefly occupied small camps in coniferous forests and subsisted on large game and wild plants. From 8,000 to 500 BC, Archaic-period Indians inhabited deciduous forests, hunted deer and small game, wove baskets, and ground seeds with stones. From 500 BC to 900 AD, Woodland culture Indians developed maize agriculture, built villages and burial mounds, invented the bow and arrow, and began making pottery. The Indians of the Mississippian culture (900-1500 AD) improved agricultural methods, and built temple mounds and large fortified villages. Most of these settlements were abandoned before the initiation of the historic period (State of Illinois 2001).

The Indian settlements that remained were the Illinois Indians, also known as the Illini or the Illiniwek. These tribes inhabited a roughly triangular area extending south and west from the Chicago River and reaching into what are now the states of Iowa, Missouri, and Arkansas. During the mid-18th century, the Illiniwek, reacting to the influx of tribal migration from the east (Iroquois migration), began to move westward. As the Illiniwek vacated the area, the Sauk, Fox, Kickapoo, and Potowatomi moved in (University of Illinois undated). In the mid-to-late 1600s, the French were the first Europeans to descend upon the upper Mississippi region. The French referred to this area as the "Illinois Country" (University of Illinois undated).

In the 17th and 18th centuries, control of the region passed through the hands of the local Indians, the French, and the British. In 1818, Illinois became the 21st state, with a population of just 34,620 (State of Illinois 2001).

Pre-Operation

The Final Environmental Statement for operation of QCNPS listed two historic (National Register of Historic Places) sites in the vicinity of the Station: the birthplace of William Cody (Buffalo Bill), located 8.5 miles southwest of QCNPS, near Le Claire, Iowa, and the Rock Island Arsenal on Rock Island, approximately 19 miles southwest of the Station (AEC 1972). When the Final Environmental Statement was published, it was determined that these sites were not affected by QCNPS. (AEC 1972). ComEd did not conduct an archaeological survey prior to construction of the Station. It did, however, contract with the Illinois Archaeological Survey to conduct a reconnaissance survey of a portion of the spray canal that was under construction in order to determine if any archaeological sites were in the area of the canal and if any damage had been done. The surveyor concluded that there was no evidence of archaeological materials in the area (Bareis 1972).

Current Status

As of 2001, the National Register of Historical Places lists 19 sites in Rock Island County (Illinois), 278 sites in Scott County (Iowa), 9 sites in Whiteside County (Illinois), and 16 sites in Clinton County (Iowa) (U.S. Department of the Interior 2001a, 2001b, 2001c, and 2001d, respectively). Of these 322 locations, only 2 fall within a 6-mile radius of QCNPS. One site is located in Whiteside County and one in Clinton County (see Table 2-9). A brief description of each of these sites is included below.

The Albany Mounds

The Middle Woodland people constructed more than 80 mounds on a high ridge in the Mississippi River floodplain just south of the

present town of Albany (Figure 2-2) in Whiteside County (Illinois State Museum 2000). Fewer than 50 of the original mounds remain, and these are owned and protected by the State of Illinois (Smith 2000). Archaeologists estimate that between 100 and 250 people inhabited this area over the course of two centuries approximately 2,000 years ago. The mounds contain the remains of these people, along with their personal belongings (Illinois State Museum 2000).

The Horace Anthony House

Mr. Horace Anthony relocated from the Northeast to Camanche, Iowa, in 1850 (Figure 2-2). He was extensively engaged in the sawmill and lumber business and was known throughout the town as an enterprising and public-spirited citizen. Mr. Anthony held several offices through the years, including County Treasurer and County Representative to the Legislature (Gen Web undated).

In addition to searching the National Register of Historical Places database, EGC contracted with the State Archaeologist of Iowa to do a file survey of the 0401 Davenport transmission line. Staff from this office surveyed the area within a 1-mile radius of the line and discovered the presence of one site, 13ST157, within the corridor (Eck 2002). Thirty-three other sites (Eck 2002) were recorded within one mile of this location but are not close enough to be impacted by transmission line maintenance activities. Site 13ST157 has been designated as a prehistoric resource procurement area (University of Iowa 1997). Cultural materials discovered at the site included fire-cracked rock, chipped stone, tools, globular cores, lithic debitage, and debris of blanding chert. The site is located on cropland owned by the Iowa Department of Natural Resources. As a consequence, the site is regularly disturbed by agricultural activities (University of Iowa 1997).

2.13 Other Projects and Activities

QCNPS is located on Mississippi River Pool 14, a reservoir that was established by the U.S. Army Corps of Engineers and continues to be subject to routine maintenance (such as dredging) by the Corps.

Approximately one mile north of QCNPS is an industrial park with several plants (Figure 2-2), the largest of which is the Minnesota Mining and Manufacturing Company (3M). This plant manufactures hydrofluorethers. Many of the plants in this complex discharge to the air and to the Mississippi River. The town of Clinton, Iowa, about 10 miles upriver, also contains several large industrial plants that influence Pool 14 environmental quality. One such plant is the M. L. Kapp Station, a 235-megawatt coal-fired electrical generating station owned by Alliant Energy (Figure 2-2).

In addition to the existing, long-term industrial base near QCNPS, there is a recently completed gas-fired generating plant less than one mile southeast of the Station (Figure 2-2). MidAmerican Energy completed the 500-megawatt Cordova Energy Center in June 2001. It withdraws makeup water for condenser cooling from groundwater, but discharges its blowdown to Pool 14 at ambient temperatures.

Table 2-1. Threatened and Endangered Species that occur in the Vicinity of QCNPS or along QCNPS Transmission Lines.

Species	Status		County Occurrences and Habitat
	Federal	State of Illinois	
Western prairie fringed orchid (*Platanthera praeclara*)	T		Scott County, Iowa[b]
Eastern prairie fringed orchid (*Platanthaera leucophaea*)	T		Scott County, Iowa[b]
Iowa pleistocene snail (*Discus macclintocki*)	E		Clinton County, Iowa[b]
Indiana bat (*Myotis sodalis*)	E		Scott County, Iowa,[a] and Rock Island and Whiteside Counties, Illinois[a]
Bald eagle (*Haliaeetus leucocephalus*)	T	T	Clinton and Scott Counties, Iowa[b], and Whiteside and Rock Island Counties, Illinois[a,c]
Higgins' eye pearly mussel (*Lampsilis higginsi*)	E	E	Clinton and Scott Counties, Iowa,[b] and Whiteside and Rock Island Counties, Illinois[a,c]
Western sand darter *Ammocrypta clarum*		E	Rock Island County, Illinois[c]
Pallid shiner *Hybopsis amnis*		E	Rock Island County, Illinois[c]
Butterfly mussel *Ellipsaria lineolata*		E	Rock Island County, Illinois[c]
Black sandshell mussel *Ligumia recta*		E	Rock Island County, Illinois[c]
River otter *Lutra canadensis*		T	Rock Island and Whiteside Counties, Illinois[c]
Western hognose snake *Heterodon nasicus*		T	Rock Island County, Illinois[c]

T = Threatened
E = Endangered
a. FWS 1999a
b. FWS 1999b
c. Appendix C.

Table 2-2. Estimated Populations and Annual Growth Rates in Whiteside, Rock Island, and Scott Counties from 1980 to 2030.

Population and Average Annual Growth Rate in the Previous Decade						
	Whiteside County		Rock Island County		Scott County	
Year	Number	Percent	Number	Percent	Number	Percent
1980	65,970[a]	0.5	165,968[a]	-0.05	160,022[b]	1.2
1990	60,186[a]	-0.9	148,723[a]	-1.0	150,979[b]	-0.6
2000	60,653[c]	0.08	149,374[c]	0.4	158,668[d]	0.5
2010	58,773[d]	-0.3	150,990[d]	0.1	171,960[e]	0.8
2020	57,987[d]	-0.1	149,574[d]	-0.09	171,283[f]	-0.04
2030	56,517[f]	-0.3	142,219[f]	-0.5	179,740[f]	0.5

a USCB (1995a).
b USCB (1995b).
c USCB (2000c).
d. Illinois Department of Commerce and Community Affairs 2001
e Iowa State University 1997.
f Tetra Tech NUS, Inc. 2001.

Table 2-3. Minority and Low-Income Populations.

County	State	2000 Block Groups	American Indian or Alaskan Native	Asian	Native Hawaiian or other Pacific Islander	Black Races	All Other Single Minorities	Multi-racial Minorities	Aggregate of Minority Races	Hispanic Ethnicity	1990 Tracts	1990Tracts Low-Income
Bureau	Illinois	21	0	0	0	0	0	0	0	0	7	0
Carroll	Illinois	20	0	0	0	0	0	0	0	0	6	0
Henry	Illinois	54	0	0	0	0	0	0	0	0	14	0
Jo Daviess	Illinois	20	0	0	0	0	0	0	0	0	6	0
Knox	Illinois	9	0	0	0	0	0	0	0	0	4	0
Lee	Illinois	28	0	0	0	1	0	0	0	0	7	0
Mercer	Illinois	18	0	0	0	0	0	0	0	0	4	0
Ogle	Illinois	16	0	0	0	0	0	0	0	0	4	0
Rock Island	Illinois	125	0	0	0	13	1	0	13	4	43	1
Stark	Illinois	6	0	0	0	0	0	0	0	0	2	0
Stephenson	Illinois	9	0	0	0	0	0	0	0	0	6	0
Warren	Illinois	4	0	0	0	0	0	0	0	0	2	0
Whiteside	Illinois	63	0	0	0	0	1	0	0	3	18	0
Cedar	Iowa	19	0	0	0	0	0	0	0	0	5	0
Clinton	Iowa	49	0	0	0	0	0	0	0	0	12	0
Dubuque	Iowa	5	0	0	0	0	0	0	0	0	2	0
Jackson	Iowa	22	0	0	0	0	0	0	0	0	6	0
Jones	Iowa	8	0	0	0	0	0	0	0	0	4	0
Louisa	Iowa	1	0	0	0	0	0	0	0	0	1	0
Muscatine	Iowa	31	0	0	0	0	1	0	2	4	10	0
Scott	Iowa	109	0	0	0	9	0	0	18	1	39	0
TOTAL		637	0	0	0	23	3	0	33	12	202	1

State Averages

States	American Indian or Alaskan Native	Asian	Native Hawaiian or other Pacific Islander	Black Races	All Other Single Minorities	Multi-racial Minorities	Aggregate of Minority Races	Hispanic Ethnicity	Low-Income
Illinois	0 25%	3 41%	0 04%	15.11%	5 82%	0 19%	24.82%	12 32%	11.47%
Iowa	0 31%	1 25%	0.00%	2.11%	1.28%	1 09%	6.07%	2.82%	11 93%

Table 2-4. Tax Information for QCNPS and Rock Island County.

Year	Total Rock Island County Levees Extended	Property Tax Paid by QCNPS	Percent of Collections Available for Distribution	Collections Available for Distribution to Districts[a]
1997	$117,997,570[c]	$3,241,673	2.8	$117,630,496
1998	$123,064,173[c]	$3,394,251	2.8	$122,356,796
1999	$129,984,935[b]	$3,524,299	2.7	$129,713,348
2000	$136,235,237[d]	$3,607,871	2.7	$135,791,633[e]

a. Alberts 2001.
b. Smock 2001.
c Coe 2001.
d. Smock 2002.
e. Alberts 2002.

Table 2-5. Rock Island County Public Water Suppliers and Capacities.

Water Supplier	Average Daily Use (Gallons per day)	Maximum Daily Capacity (Gallons per day)
Andalusia	110,000	216,000
East Moline	4,616,000	10,432,000
Hampton	142,000	2,300,000
Milan	877,000	4,075,000
Moline	6,350,000	13,000,000
Rock Island	4,800,000	16,000,000
Silvis	537,000	3,052,000
Coal Valley	537,000	1,152,000
Croppers 1st, 4th, & 5th ADDN	65,000[a]	258,000
Rock Island Arsenal	650,000	1,720,000
Silvis Heights Water Corp.	121,000	778,000

Source: Illinois Environmental Protection Agency 2001a and 2001b.
a. The "average maximum use" value was used because the "average daily use" was unavailable.

Table 2-6. Whiteside County Public Water Suppliers and Capacities.

Water Supplier	Average Daily Use (Gallons per day)	Maximum Daily Capacity (Gallons per day)
Erie	120,000	683,000
Fulton	438,000	1,123,000
Morrison	912,000	2,520,000
Prophetstown	221,000	1,080,000
Rock Falls	1,297,000	4,032,000
Illinois American Water Co.- Sterling	2,700,000	7,070,000

Source: Illinois Environmental Protection Agency 2001a and 2001b.

Table 2-7. Scott County Public Water Suppliers and Capacities.

Water Supplier	Average Daily Use (Gallons per day)	Maximum Daily Capacity (Gallons per day)
Park View Water Company	138,000	Not Available
Buffalo Water Supply	142,000	228,000
Blue Grass Water Supply	137,400	600,000
Walcott Water Supply	228,000	662,400
Eldridge Water Supply	436,000	500,000
Iowa-American Water Company – Davenport	17,784,000	30,000,000
LeClaire Utilities Department	226,000	Not Available

Source. Iowa Department of Natural Resources 2001

Table 2-8. Traffic Count Data for Highways near QCNPS.

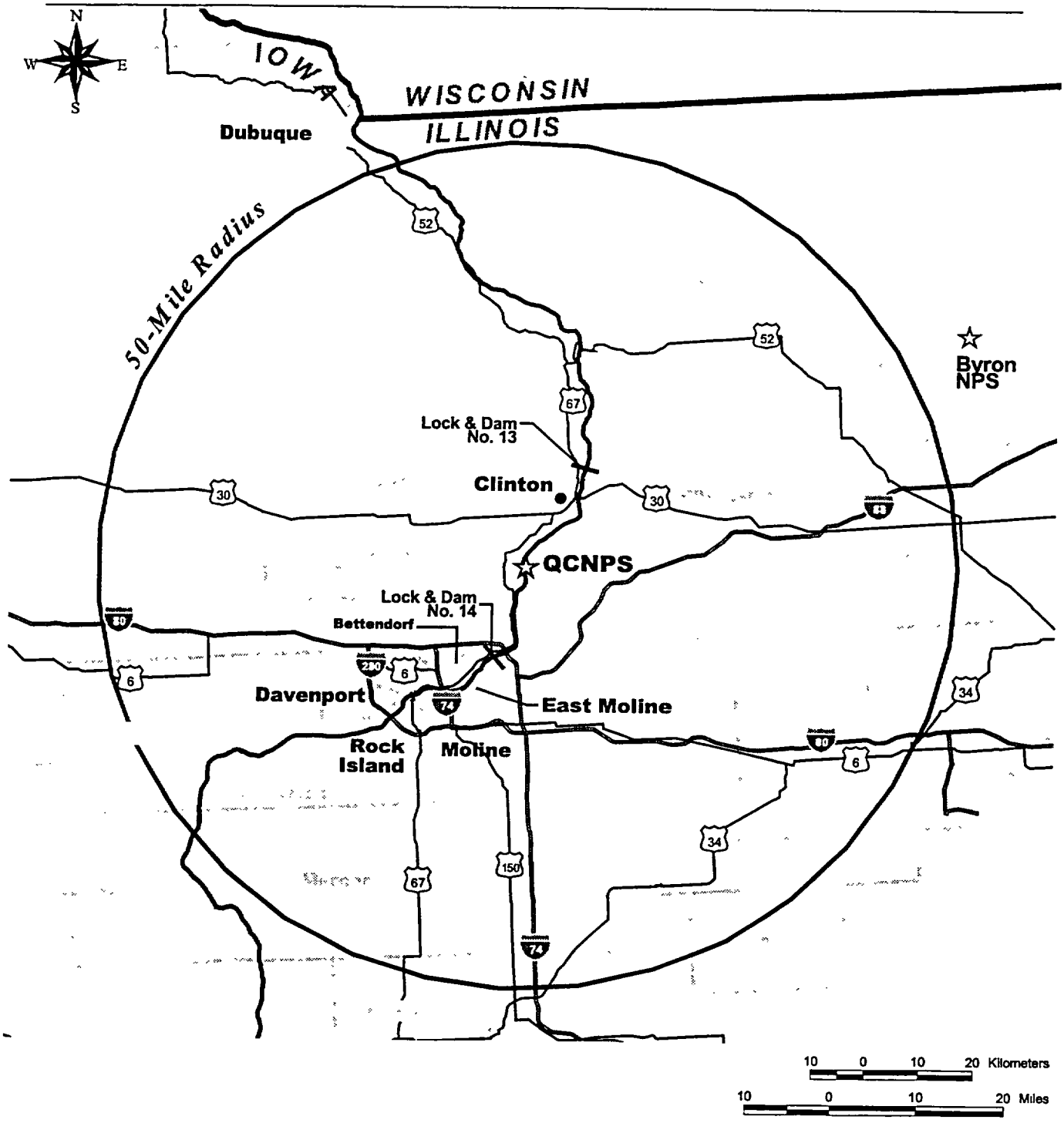
Route No./ Road Name	Route Location	Estimated AADT	AADT Year
State Route 84	North of 157th Avenue[a]	4,500	1996
State Route 84	South of 157th Avenue	4,450	1996
Interstate 80	North of State Route 84	23,600	1999
Interstate 80	South of State Route 84	25,400	1999

Source: Wild 2001
AADT = Annual Average Daily Traffic volumes.
a 157th Avenue is in downtown Cordova, Illinois

Table 2-9. Sites on the National Register of Historic Places within a Six-Mile Radius of QCNPS.

Site Name	City	Location
	Whiteside County	
Albany Mounds Site	Albany, Illinois	Address Restricted
	Clinton County	
Horace Anthony House	Camanche, Iowa	1206 Anthony Place

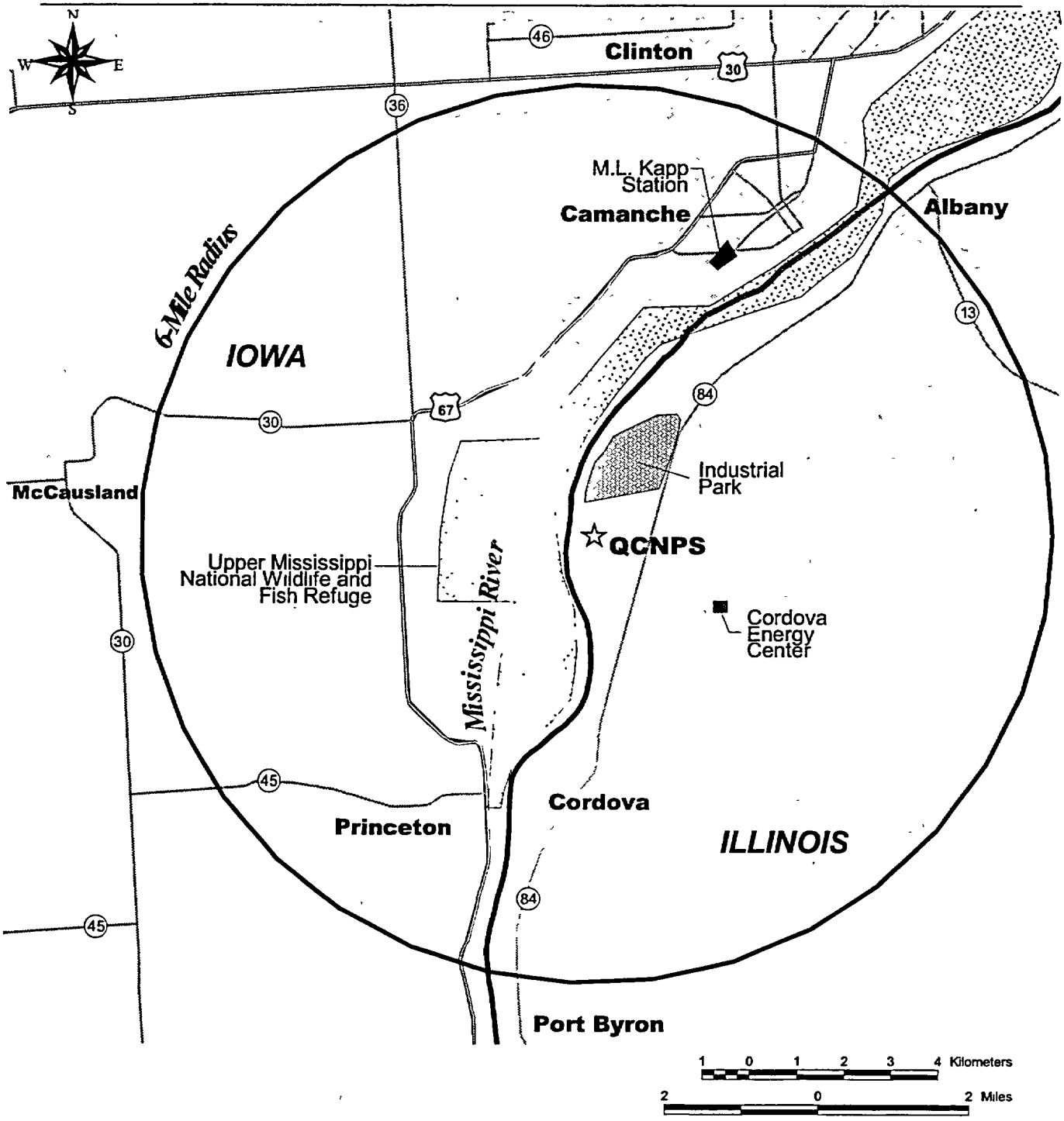
Source U S Department of the Interior 2001c and 2001d.



LEGEND

- ☆ Nuclear Power Plants
- County Boundaries
- Lakes and Rivers
- Urban

FIGURE 2-1
50-Mile Vicinity Map



LEGEND

- ☆ Quad Cities Nuclear Station
- County Boundaries
- Lakes and Rivers
- Cities

FIGURE 2-2
6-Mile Vicinity Map

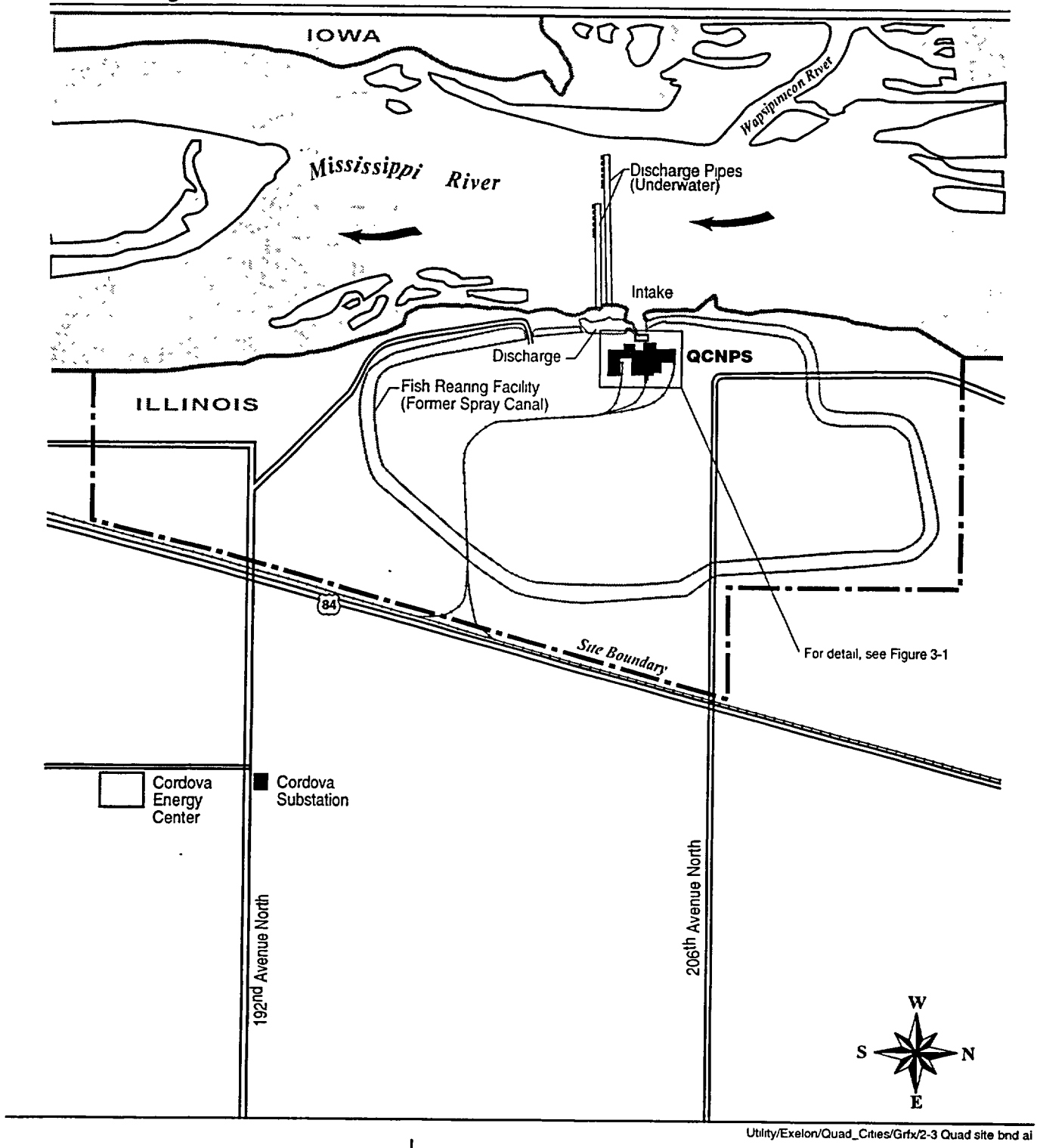
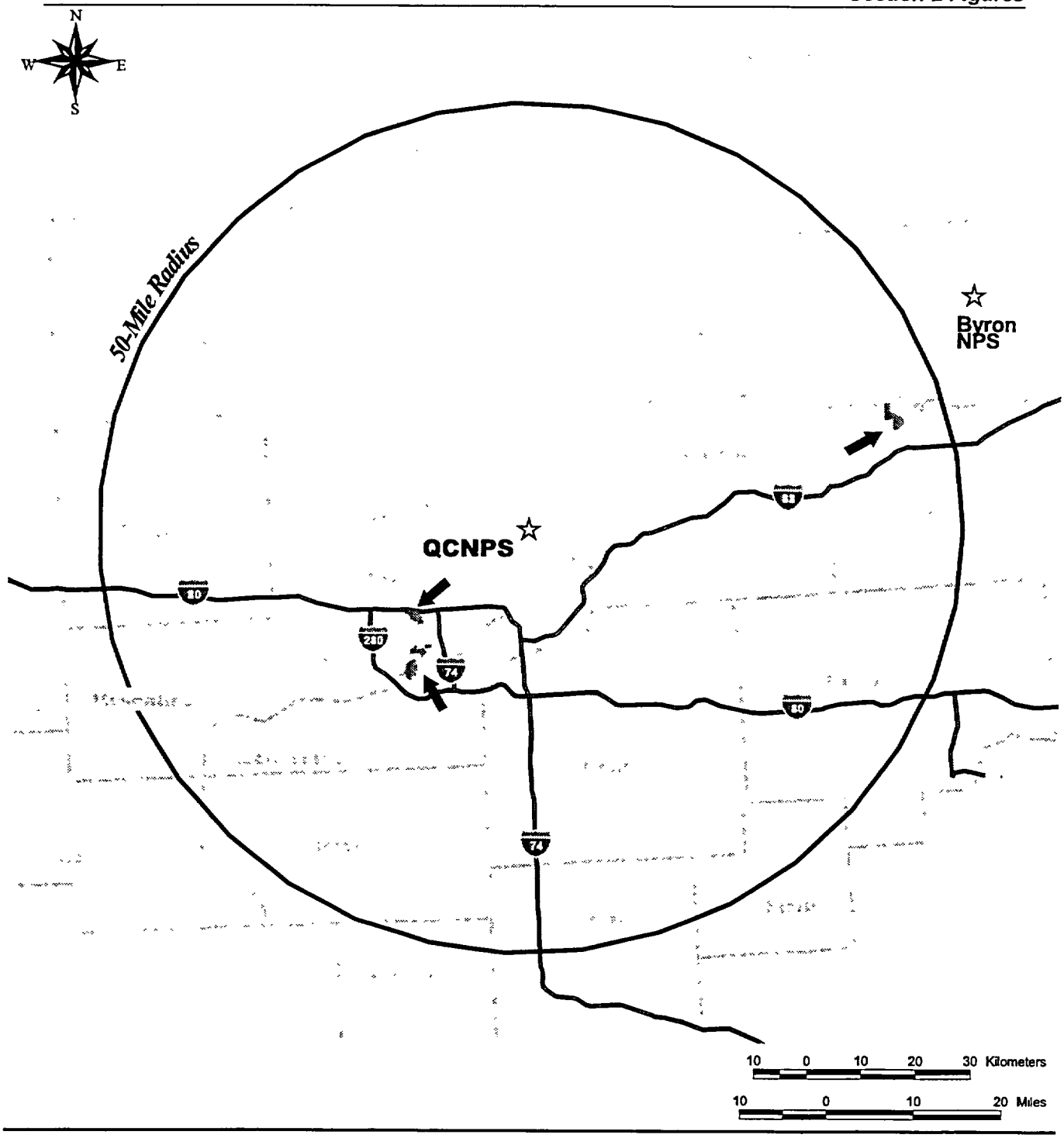


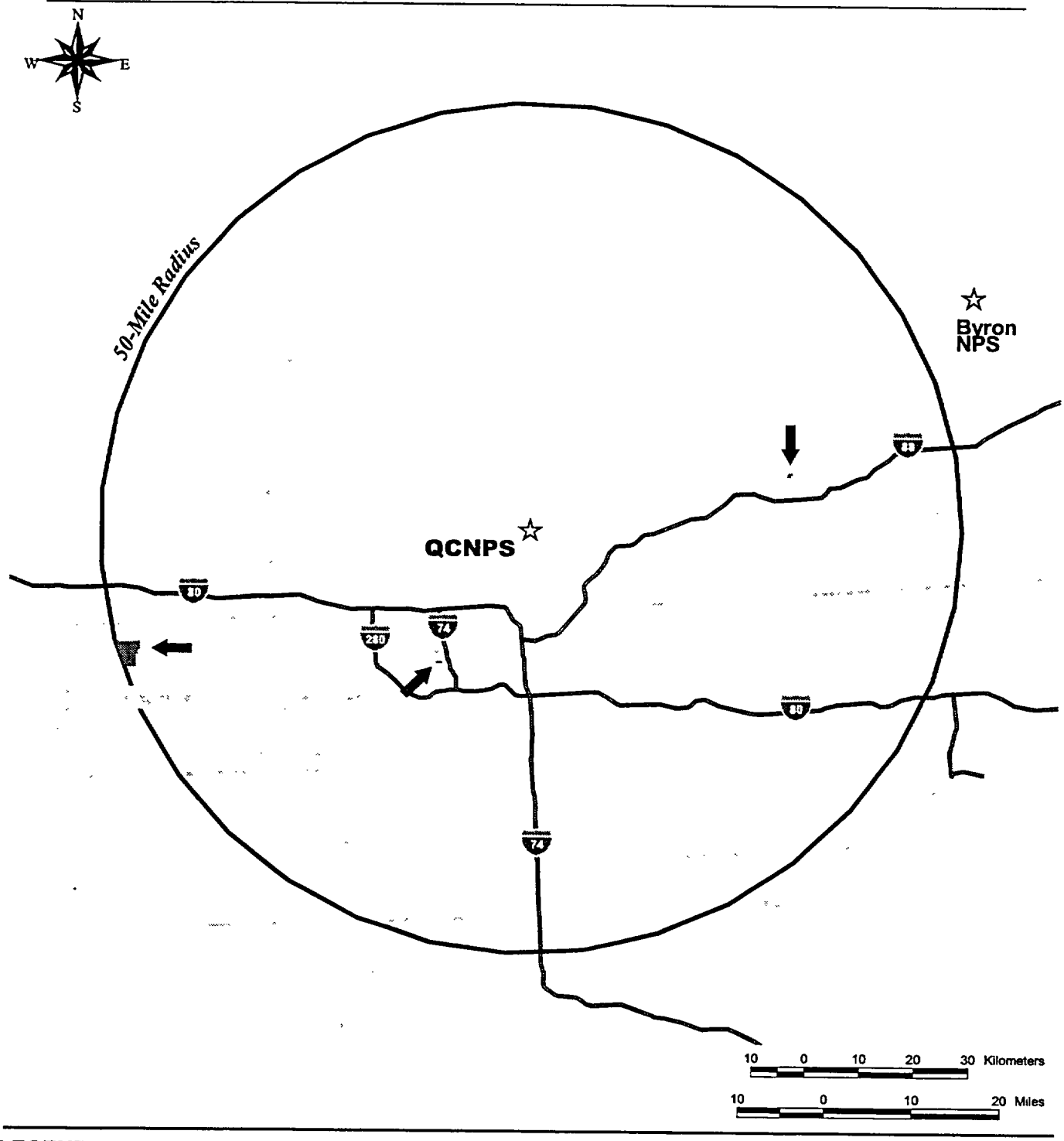
FIGURE 2-3
Site Boundary



LEGEND

- Black Minority Populations
- Nuclear Power Plants
- County Boundaries
- Identifying small Block Groups

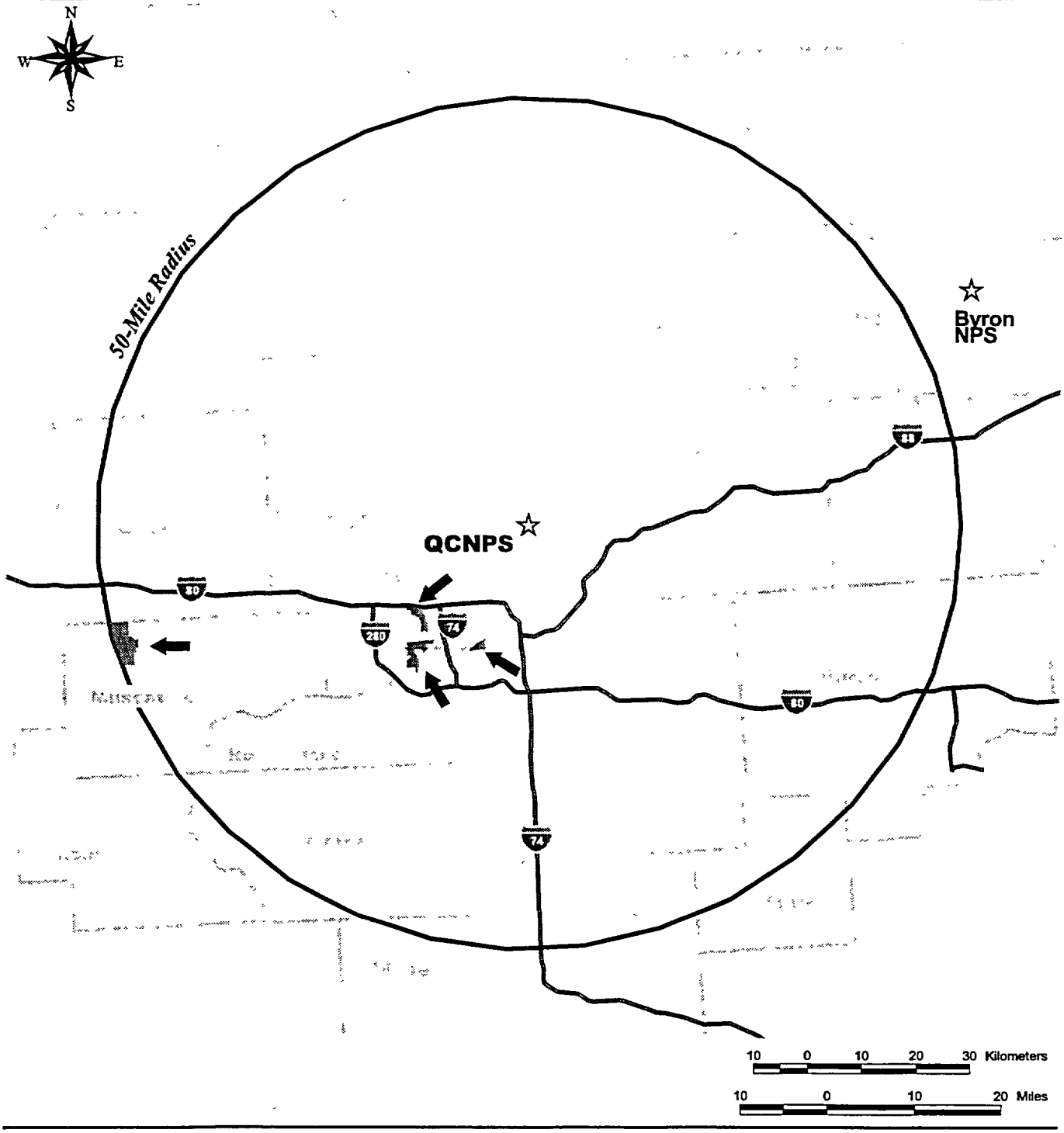
FIGURE 2-4
Black Minority Populations



LEGEND

- Other Minority Populations
- Nuclear Power Plants
- County Boundaries
- Identifying small Block Groups

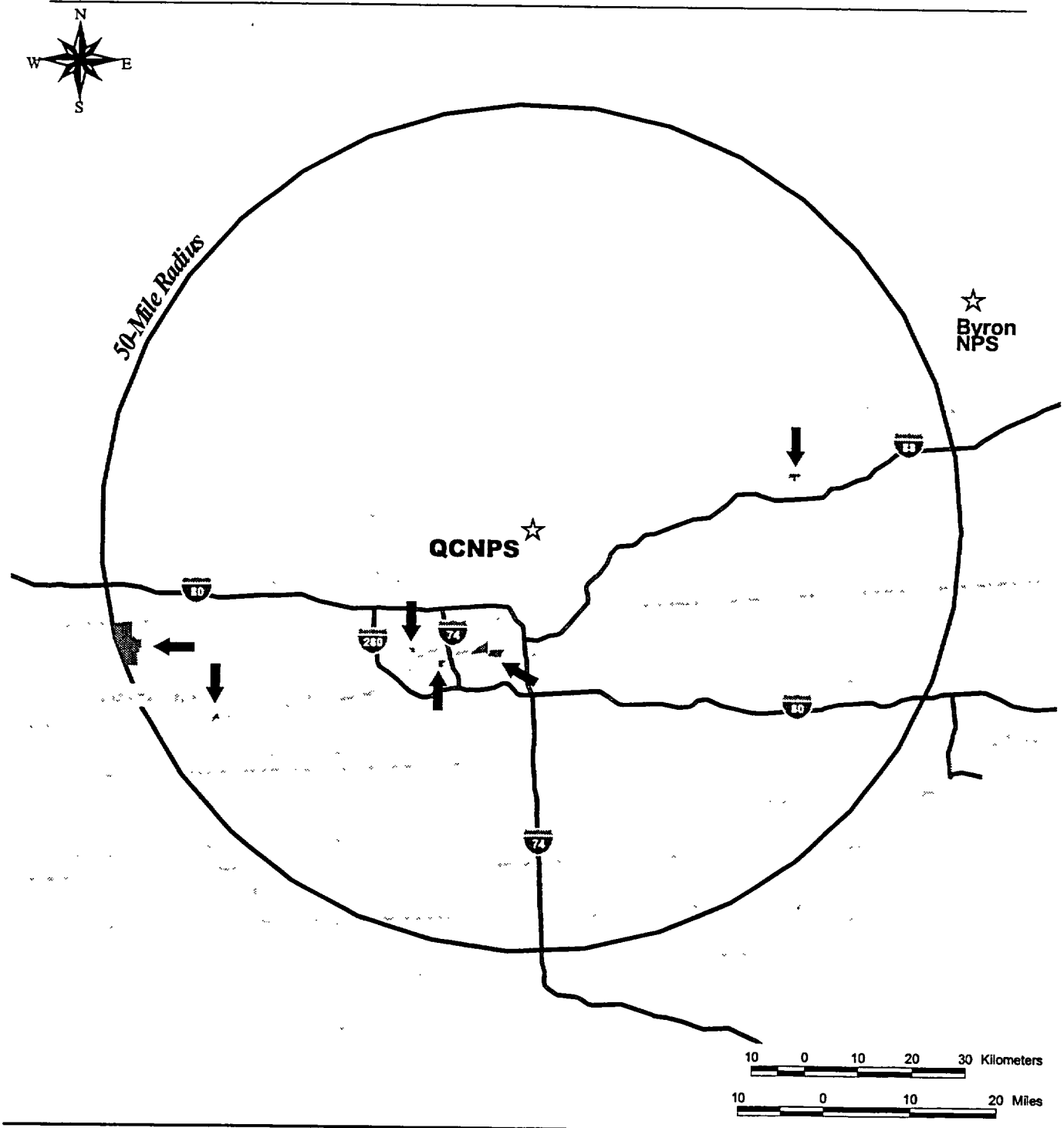
FIGURE 2-5
Other Minority Populations



LEGEND

- Aggregate Minority Populations
- Nuclear Power Plants
- County Boundaries
- Identifying small Block Groups

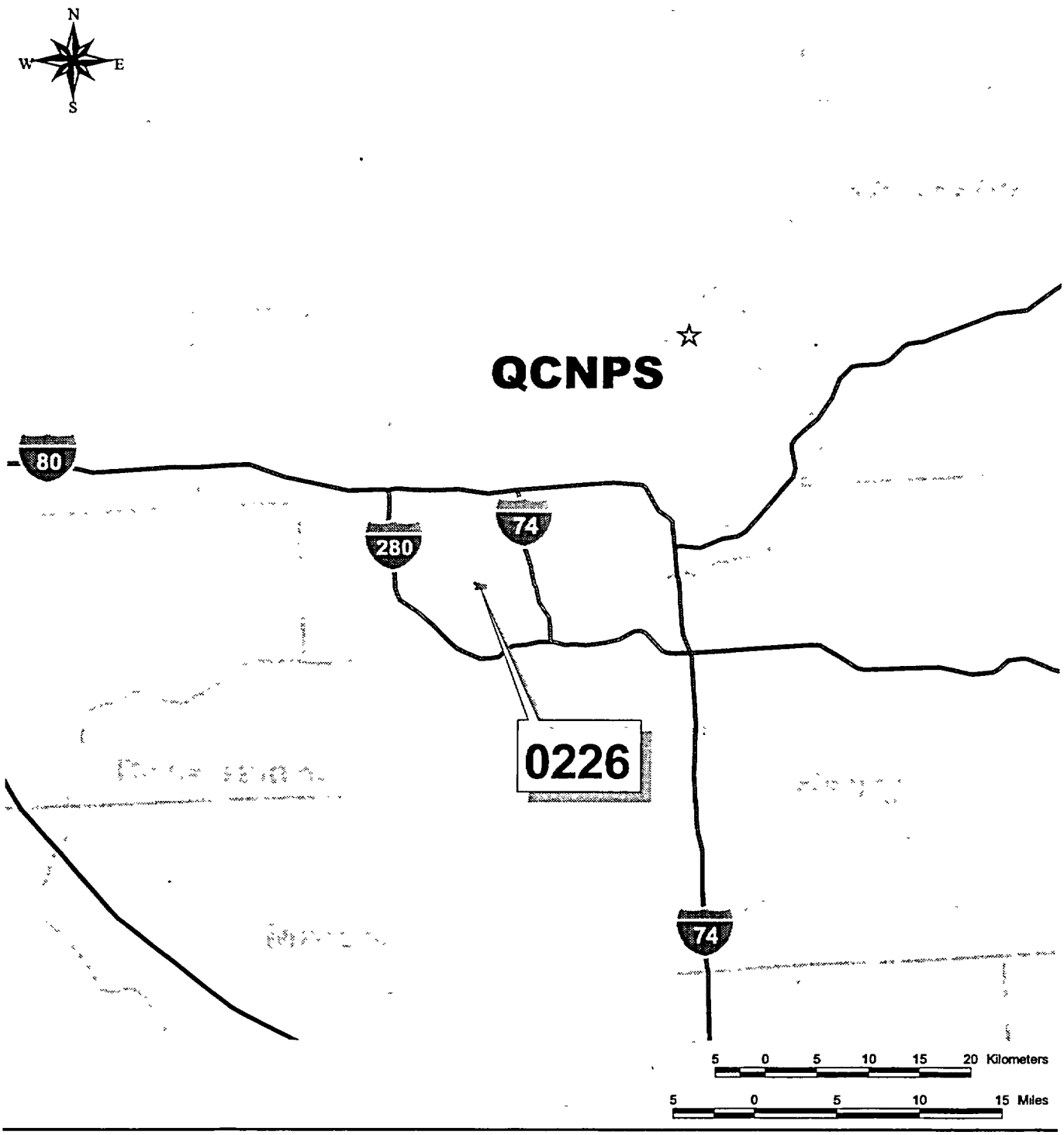
FIGURE 2-6
Aggregate Minority Populations



LEGEND

- Hispanic Minority Populations
- Nuclear Power Plants
- County Boundaries
- Identifying small Block Groups

FIGURE 2-7
Hispanic Ethnicity Minority Populations



LEGEND

- Low-Income Populations
- Nuclear Power Plants
- County Boundaries

FIGURE 2-8
Low-Income Populations

2.14 References

Note to reader: Some web pages cited in this document are no longer available, or are no longer available through the original URL addresses. Hard copies of all cited web pages are available in EGC files. Some sites, for example the census data, cannot be accessed through their URLs. The only way to access these pages is to follow queries on previous web pages. The complete URLs used by EGC have been given for these pages, even though they may not be directly accessible.

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Chapter 3

Proposed Action

NRC

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

EGC proposes that NRC renew the operating licenses for QCNPS Units 1 and 2 for an additional 20 years beyond the current license expiration date of December 14, 2012. Renewal would give EGC and the State of Illinois the option of relying on QCNPS to meet future electricity needs Section 3.1 discusses the major features of the Station and the operation and maintenance practices directly related to the license renewal period. Sections 3.2 through 3.4 address potential changes that could occur as a result of license renewal.

3.1 General Plant Information

QCNPS is a two-unit, nuclear-powered steam electric generating facility that began commercial operation on February 18, 1973 for Unit 1 and March 10, 1973 for Unit 2. Each unit is powered by a General Electric Company boiling water reactor (BWR) that produces 2,957 megawatts-thermal. The design net electrical capacity is 930 megawatts electric per unit. Figure 3-1 depicts the Station layout.

3.1.1 REACTOR AND CONTAINMENT SYSTEMS

The nuclear steam supply system at QCNPS is typical of General Electric BWRs. The reactor core produces heat that boils the reactor water into steam which, after drying, is routed to the turbines. The steam yields its energy to turn the turbines, which are connected to the electrical generator. QCNPS uses a BWR 3 reactor and a Mark I primary containment. The nuclear fuel is low-enriched uranium dioxide with enrichments below 5 percent by weight uranium-235 and fuel burnup levels less than 60,000 megawatt-days per metric ton uranium.

The primary containment for each unit consists of a drywell, a steel structure that encloses the reactor vessel and related piping, a toroidal-shaped pressure suppression chamber containing a large volume of water, and a vent system that connects the drywell to the suppression chamber. The primary containment is designed to condense steam released during a postulated loss-of-coolant accident, to limit the release of fission products associated with such an accident, and to serve as a source of water for the emergency core cooling system. The containment is designed to withstand an internal pressure of 62 pounds per square inch above atmospheric pressure.

The concrete reactor building, which houses the primary containment for both units, serves as a radiation shield and fulfills a secondary containment function. Secondary containment is needed to provide a controlled, filtered, elevated release of the building atmosphere under accident conditions. The reactor building provides primary containment protection when the drywell is opened for maintenance during outages.

The reactor building is maintained under a slight negative pressure, with the building exhaust monitored before release to the atmosphere through the reactor building ventilation exhaust stack. Radiation monitors on the exhaust stream can isolate the ventilation system in the event of a process upset that could release excess radioactivity to the environment. A standby gas treatment system is provided to filter and delay the exhaust before discharging it to the 310-foot main stack.

3.1.2 COOLING AND AUXILIARY WATER SYSTEMS

The water systems most pertinent to license renewal are those that draw from surface water bodies and groundwater. At QCNPS, the once-through circulating water system draws from and discharges to the Mississippi River. This system removes heat rejected from the main condenser. The service water system also draws from the river. Groundwater from five wells is used for domestic water consumption, raising fish in the former spray canals, and for other industrial purposes that do not include condenser cooling. The subsections below describe these three systems.

Circulating Water System

Condenser cooling water is withdrawn from the Mississippi River through a canal that is perpendicular to the river flow. The canal is 235 feet long, 180 feet wide, and 12 feet deep where it meets the river. Intake

velocity at the mouth of the canal is about one foot per second. A floating boom, extending to a depth of 33 inches, traverses the mouth of the canal to deflect floating material. At the other end of the canal is a trash rack consisting of a series of vertical metal bars spaced 2.5 inches apart that screens large pieces of debris from the intake. The circulating water pumps are further protected by sets of traveling screens that have a 3/8-inch mesh. Therefore, organisms larger than this mesh are prevented from entering the cooling system.

The cooling system discharge has historically had several configurations. The original design called for open-cycle discharging of heated effluent along a straight wing dam into the deeper, higher velocity portion of the river. This system was used for about eight months in 1972, after which QCNPS used a two-pipe diffuser system in the river. The two diffuser pipes lie across the bottom of the main river channel and have regularly spaced jets directing heated water into the river.

An agreement reached in 1972 with stakeholders required installation of a closed-cycle condenser cooling system by 1975. The closed-cycle system included a spray canal with blow-down directed into a third diffuser pipe in the river. The spray canal that was constructed is 16,000 feet long, 185 feet wide, and 9 feet deep; it had 328 spray nozzles used to cool heated water via evaporation. QCNPS began partial closed-cycle operation in 1974 and achieved full closed-cycle operation in 1975. The spray canal was considerably less efficient than anticipated and, in 1979, revisions to the discharge permit and an agreement with the stakeholders allowed partial open-cycle operation of the circulating water system.

Based on an extensive study of the diffuser system, it was concluded that QCNPS could operate at full load in the open-cycle mode while meeting permit limits under most river flow conditions (ComEd 1981). To demonstrate compliance at low river flows, EGC developed a temperature monitoring curve that allowed calculation of permissible plant load as a function of river flow. With these data and the lack of biological effects in the river, as demonstrated by ongoing monitoring, the parties agreed in 1983 to allow open-cycle operation (Open-Cycle Agreement 1983). The temperature monitoring curve was last modified in 2001 to more accurately represent current conditions. The curve may continue to be modified over the license renewal period, under agreement with the affected parties.

Today, the Station operates in full open-cycle with approximately 940,000 gallons per minute (gpm) discharged to the river with two units running at full power. The direction of flow through the condensers is reversed as needed to prevent biological fouling of the condenser tubes. The combined cooling and service water, heated 28 degrees Fahrenheit (F) above the intake temperature, is discharged through two 16-foot-diameter diffuser pipes with nozzles that jet the water into the deepest part of the river channel. The biocides, chlorine and bromine, are used at the condenser inlets to minimize aquatic growth and bacteria in the condenser tubes QCNPS injects a chemical to neutralize the biocide in the discharge bay so that river organisms are not affected by the biocide. Additionally, a silt dispersant and a scale inhibitor are injected at the river intake. The spray canal is no longer used in the circulating water system, but is used instead to raise fish.

Service Water System

This system provides strained water from the Mississippi River for cooling several closed cooling water systems, the recirculation motor-generator set oil coolers, the generator stator coolers, the turbine oil coolers, the generator hydrogen coolers, and other systems. It also is used to wash the circulating water traveling screens and to pressurize the fire header. The flow rate

is variable, but maximum capacity is 69,000 gpm.

The service water pumps draw from the same intake system as the circulating water system. The pumps discharge through strainers with automatic self-cleaning capability. Biocide, silt dispersant, and a corrosion inhibitor can be injected into the service water system, if needed. The system discharges to the Station discharge flume that leads to the diffusers.

Groundwater Systems

There are currently five operating wells providing water to various systems on the QCNPS property (Figure 3-1). The two primary wells for Station operations, Wells 1 and 5, pump up to 200 and 400 gpm, respectively. These wells provide water to a 200,000-gallon storage tank, which is used as a source of water for the domestic drinking water system, the make-up demineralizer system, and the gland seal condenser. The largest single use of groundwater is to maintain the former spray canal for raising fish (see Section 3.1.4). Water for this purpose is drawn from Well 7, which can pump at 3,000 gpm. Well 6 is also used to feed the spray canal at a 150-gpm capacity. The final well, Well 8, provides fire training water at 250 gpm. Wells 2, 3, and 4 have been capped or abandoned.

During 1997, the Station was down during the winter months. During this time, groundwater from Well 7 was pumped to the fish rearing facility to maintain its water temperature. This use raised the yield of the well to approximately 2,500 gpm from a normal average of approximately 418 gpm. Wells 1, 5, and 8 are approximately the same depth (approximately 250 feet). The depth of Well 7 is approximately 180 feet. EGC has not observed an increase in water-level depth measurements collected from onsite wells while pumping from site wells. Based on this, EGC does not see evidence of any impact to the local aquifers or to offsite users.

3.1.3 TRANSMISSION FACILITIES

The Final Environmental Statement (FES) (AEC 1972) identifies four transmission lines that were built to connect QCNPS to the electric grid. The lines are the 0401 line to the Davenport substation near Davenport, Iowa, the 0402 line to the Barstow substation near Rock Island, Illinois, and the 0403 and 0404 lines to the Nelson substation near Rock Falls, Illinois. The two Nelson lines, known as the North line and the South line, are owned by ComEd and were commissioned in 1969 and 1971, respectively. The other two lines are owned by MidAmerican Energy Company and were built from 1968 to 1970. All four lines operate at 345 kilovolts. These lines were planned before QCNPS was built and would have been constructed to connect to an alternate source of power, had the Station not been built.

Subsequent to the publication of the FES, four changes were made to the transmission system.

- Alliant Energy constructed a fifth line in 1987. It is the 0405 line to the Rock Creek substation near Comanche, Iowa. This line also operates at 345 kilovolts.

- In 2000, a new substation was built approximately two miles from QCNPS, adjacent to a new gas-fired plant built by MidAmerican Energy. The 0403 Nelson south line now connects to this substation, which then connects to the switchyard of the MidAmerican plant.

- The 0402 Barstow line was also connected to the MidAmerican plant switchyard.

- The 0401 Davenport line was connected to a new substation (TSS 91) just north of Davenport.

As a result of these system changes, the transmission lines of interest for this report are somewhat different than those described in the FES as described below. Figure 3-2 is a map of the transmission system of interest.

- Davenport (0401) – The corridor for the Davenport line runs south from QCNPS and then turns west, crossing the Mississippi River to substation 91. The line runs 12.8 miles and has a 180-foot right-of-way. The environment is mostly flat farmland with some wooded area.

- Barstow (0402) – In the FES, this line is described as running 17.5 miles to the Barstow substation near Rock Island, Illinois. Currently, the line runs only 2 miles to the MidAmerican Energy plant southeast of QCNPS. It shares towers with the south Nelson line on a 520-foot right-of-way. The remainder of the original Barstow line is now beyond the point at which QCNPS is connected to the electrical grid.

- Nelson (0403) – In the FES, this line is described as running 41.9 miles to the Nelson substation. Currently, this line provides power to a new substation approximately two miles southeast of the Station, across from the new MidAmerican gas-fired plant. The remainder of the original south Nelson line is now beyond the point at which QCNPS is connected to the electrical grid. The right-of-way width is 520 feet for the approximately two miles that the line shares the corridor with the Barstow line.

  Nelson (0404) – In the FES, this line is described as running 39.7 miles east from the Station and connecting with the Nelson substation near Rock Falls, Illinois. Currently, the Nelson 0404 line terminates at the Northwestern Steel and Wire substation 33 miles from QCNPS. It is the northernmost of the two Nelson lines. The right-of-way is 145 feet wide. The terrain is mostly flat farmland. The remainder of the original north Nelson line is now beyond the point at which QCNPS is connected to the electrical grid.

- Rock Creek (0405) – This line runs through the industrial park just north of QCNPS and then crosses the river into Iowa. It terminates in the Rock Creek substation, which is near Comanche, Iowa. The right-of-way is 170 feet wide and runs 5 miles.

In total, for the specific purpose of connecting QCNPS to the transmission system, ComEd, Alliant Energy, and MidAmerican Energy have approximately 53 miles of corridor that occupy approximately 1,100 acres. The corridors pass through land that is primarily flat farmland with a minimal amount of forest. The areas are mostly remote, with low population densities. The longer lines cross numerous state and U.S. highways, including I-80. Corridors that pass through farmlands generally continue to be used in this fashion. ComEd, Alliant Energy, and MidAmerican Energy plan to maintain these transmission lines, which are integral to the larger transmission system, indefinitely. These transmission lines will remain a permanent part of the transmission system after QCNPS is decommissioned.

ComEd, Alliant Energy, and MidAmerican Energy designed and constructed all QCNPS transmission lines in accordance with the Illinois Commerce Commission General Order 160, which is identical to the National Electrical Safety Code (IEEE 1997), and industry guidance that was current when the lines were built. Ongoing right-of-way surveillance and maintenance of QCNPS transmission facilities ensure continued conformance to design standards. These maintenance practices are described in Sections 2.4 and 4.13.

3.1.4 FISH REARING FACILITY

QCNPS briefly operated in a closed-cycle mode, in which a three-mile cooling canal with spray coolers was used to cool the circulating water. The 1983 conversion to once-through cooling left the canal unused. Discussions with state agencies and other interested parties led EGC to convert the spray canal to a fish rearing facility (Figure 2-3). The fish culture project had two objectives: (1) to produce large numbers of game fish fingerlings at low cost, and (2) to determine whether stocking a large river can create new fisheries or enhance existing ones.

QCNPS now uses the spray canal and a fisheries laboratory to produce walleye and hybrid striped bass fingerlings for stocking in Pool 14. Walleye fry are produced from adults captured locally in the Mississippi river. The fry are held in the laboratory for two to three days before being placed into the spray canal. After two to three months in the canal, walleye are two- to four-inch long fingerlings and are ready for stocking.

Methods for rearing hybrid striped bass have varied over the years. At present, hybrid striped bass fingerlings (1-2 inches) are purchased in Arkansas and held in the fisheries laboratory for the entire rearing period. After three to four months, the largest individuals (6-7 inches) are graded from the small fish, marked with spaghetti tags and stocked into the Mississippi River. The smaller hybrids remain in the laboratory throughout the winter rearing period until they are approximately 10 months old. At that time, these large, yearling fish are also marked with spaghetti tags prior to their release in the river.

3.2 Refurbishment Activities

NRC

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

"... The incremental aging management activities carried out to allow operation of a nuclear power plant beyond the original 40-year license term will be from one of two broad categories: (1) SMITTR actions, most of which are repeated at regular intervals, and (2) major refurbishment or replacement actions, which usually occur fairly infrequently and possibly only once in the life of the plant for any given item...." NRC 1996, Section 2.6.3.1, pg. 2-41. (SMITTR is defined in NRC 1996, Section 2.4, pg. 2-30, as surveillance, monitoring, inspections, testing, trending, and recordkeeping.)

EGC has addressed refurbishment activities in this environmental report in accordance with NRC regulations and complementary information in the NRC *Generic Environmental Impact Statement for License Renewal of Nuclear Plants* (GEIS) for license renewal (NRC 1996). NRC requirements for the renewal of operating licenses for nuclear power plants include the preparation of an integrated plant assessment (IPA) (10 CFR 54.21). The IPA must identify and list systems, structures, and components subject to an aging management review. Items that are subject to aging and might require refurbishment include, for example, the reactor vessel, piping, supports, and pump casings (see 10 CFR 54.21 for details), as well as those that are not subject to periodic replacement.

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

The QCNPS IPA conducted by EGC under 10 CFR 54 has not identified the need to undertake any major refurbishment or replacement actions to maintain the functionality of important systems, structures, and components during the QCNPS license renewal period. EGC has included the IPA as part of its license renewal application.

3.3 Programs and Activities for Managing the Effects of Aging

NRC

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

"...The incremental aging management activities carried out to allow operation of a nuclear power plant beyond the original 40-year license term will be from one of two broad categories: (1) SMITTR actions, most of which are repeated at regular intervals, and (2) major refurbishment or replacement actions, which usually occur fairly infrequently and possibly only once in the life of the plant for any given item...." NRC 1996, Section 2.6.3.1. (SMITTR is defined in NRC 1996, Section 2.4, as surveillance, monitoring, inspections, testing, trending, and recordkeeping.)

The IPA required by 10 CFR 54.21 identifies the programs and inspections for managing aging effects at QCNPS. These programs are described in the *Application for Renewed Operation Licenses, Quad Cities Nuclear Power Station, Units 1 and 2,* Appendix B.

3.4 Employment

Current Workforce

EGC employs a permanent workforce of approximately 850 workers and an additional 130 contract and matrixed workers at QCNPS to operate two functioning reactors. This is less than the range of 600 to 800 personnel per reactor unit estimated in the GEIS (NRC 1996). Approximately 77 percent of the QCNPS employees live in Rock Island and Whiteside Counties (Illinois) or in Scott County (Iowa) (see Section 2.6). Figure 2-1 shows the locations of these counties.

QCNPS is on a 24-month refueling cycle. During refueling outages, site employment increases above the 850 permanent workforce by roughly 1,100 workers for temporary (approximately 20 days) duty. This number is above the GEIS range of 200 to 900 additional workers per reactor outage.

License Renewal Increment

EGC does not anticipate that license renewal activities described in Section 3.3 would necessitate increasing QCNPS staff workload by some increment.

The GEIS (NRC 1996) assumes that NRC would renew a nuclear power plant license for a 20-year period, plus the duration remaining on the current license, and that NRC would issue the renewal approximately 10 years prior to license expiration. In other words, the renewed license would be in effect for approximately 30 years. The GEIS further assumes that the utility would initiate SMITTR activities at the time of issuance of the new license and would conduct license renewal SMITTR activities throughout the remaining 30-year life of the plant, sometimes during full-power operation (NRC 1996), but mostly during normal refueling and the 5- and 10-year in-service refueling outages (NRC 1996).

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

The GEIS estimates that the maximum additional personnel needed to perform license renewal SMITTR activities would typically be 60 persons during the 3-month duration of a 10-year in-service refueling. Having established this upper limit for what would be a single event in 20 years, the GEIS uses this value as the expected number of additional permanent workers needed per unit attributable to license renewal. GEIS Section C.3.1.2 uses this approach in order to "...provide a realistic upper bound to potential population-driven impacts...."

EGC expects that existing "surge" capabilities for routine activities, such as outages, will enable EGC to perform the increased SMITTR workload without adding QCNPS staff. Therefore, for analysis purposes, EGC conservatively assumes that QCNPS would require no more than 60 additional permanent workers to perform all license renewal SMITTR activities.

Adding permanent employees to the plant workforce for the license renewal operating term would also have the indirect effect of creating additional jobs and spurring related population growth in the community. EGC has used an employment multiplier appropriate to the region (3.31) to calculate the total direct and indirect jobs in service industries that would be supported by the spending of the QCNPS workforce (BEA 2001). The addition of 60 license renewal employees would generate approximately

139 indirect jobs. This number was calculated as follows:

60 (additional employees) x 3.31 (regional multiplier) = 199 (total employees). Of these, 60 would be direct employees and 139 would be indirect. Seventy-seven percent of the direct and indirect workforce (153 employees) would be distributed across potentially impacted communities in Rock Island, Whiteside, and Scott Counties.

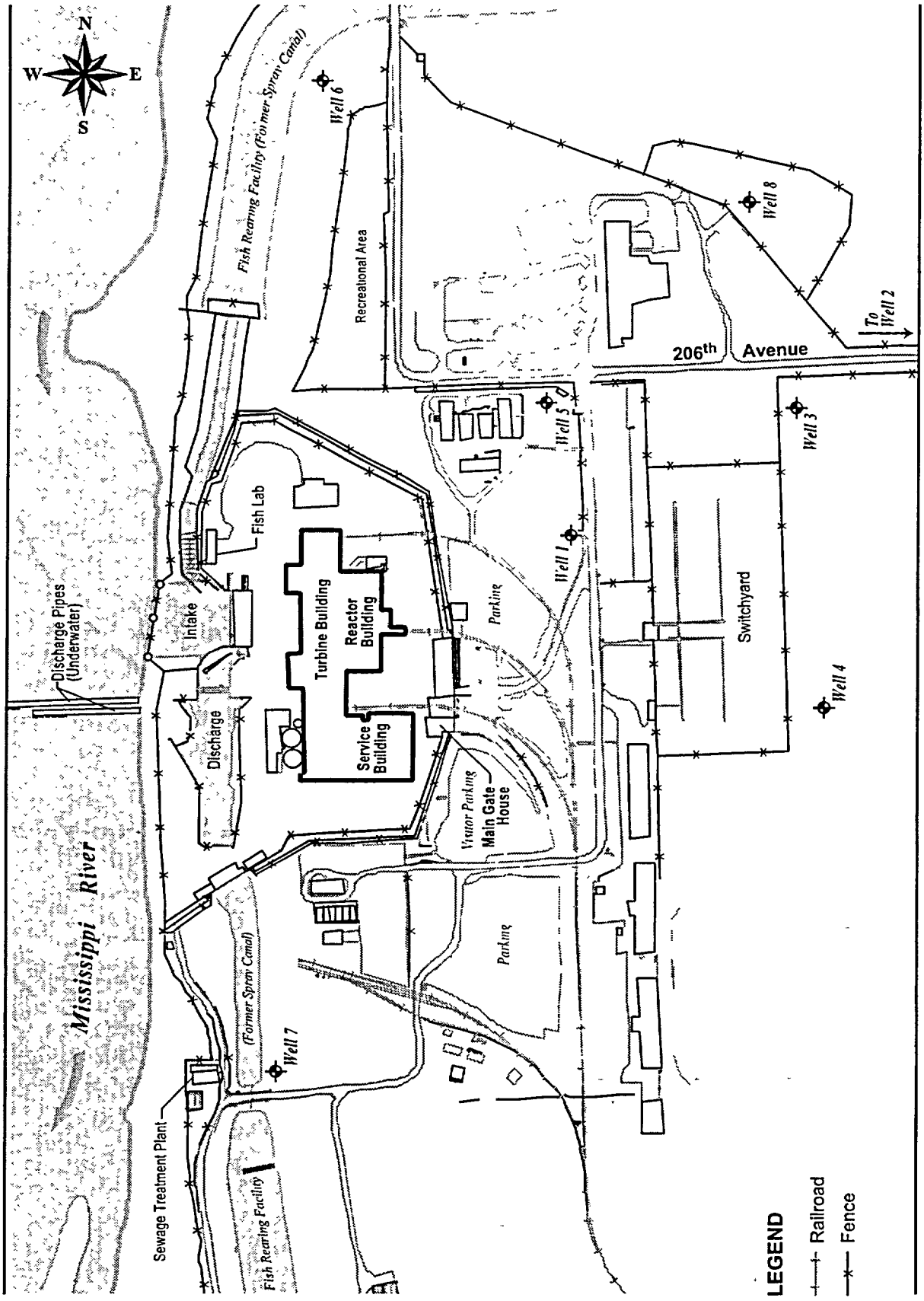
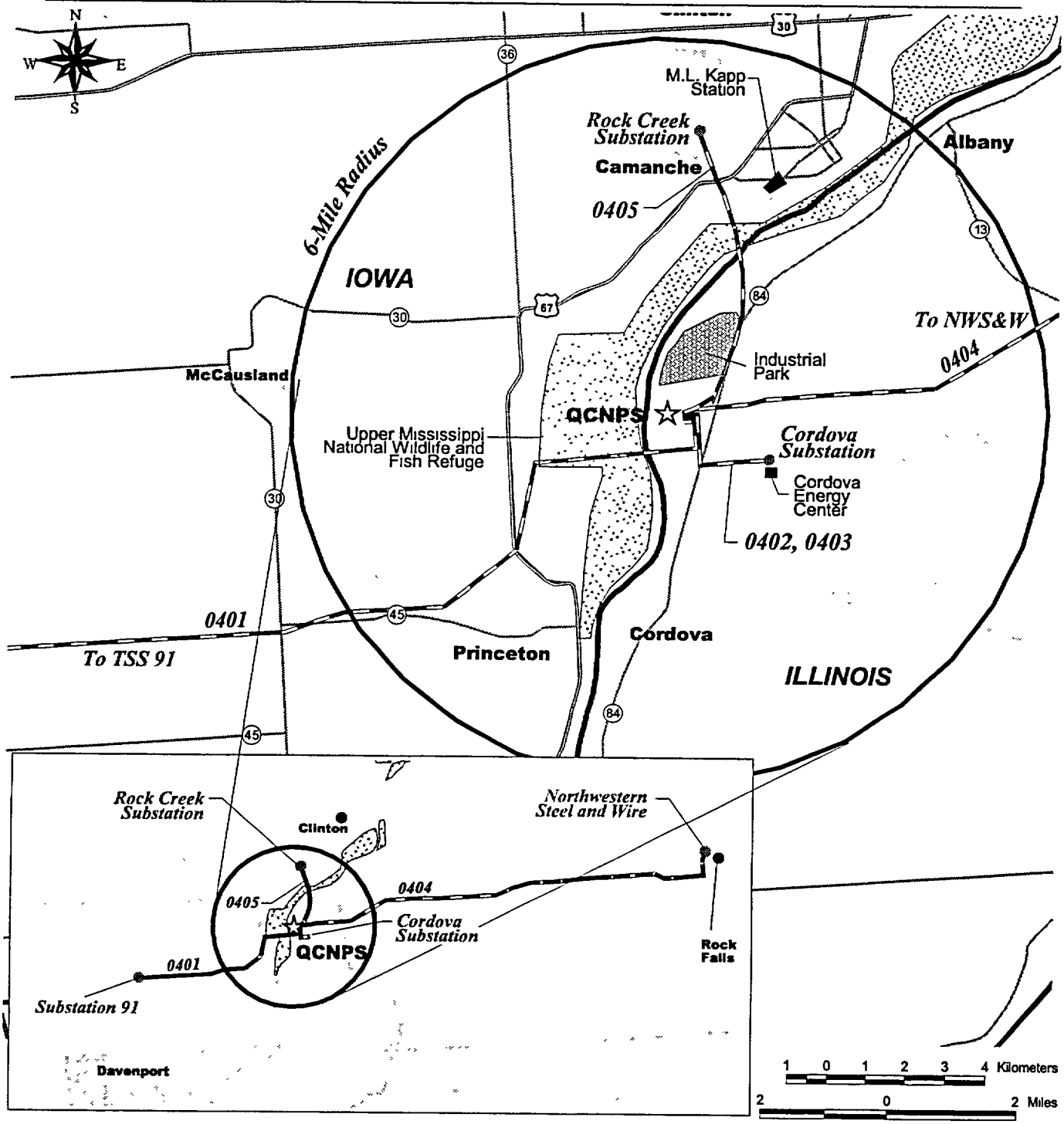


FIGURE 3-1. Station Layout



LEGEND

- Substations
- Quad Cities Nuclear Station
- Transmission Lines
- County Boundaries
- Cities

NWS&W = Northwestern Steel and Wire

FIGURE 3-2
Transmission Line Map

3.5 References

AEC (U.S. Atomic energy Commission), 1972. *Final Environmental Statement Related to Operation of Quad Cities Nuclear Power Station, Units 1 & 2*, Docket Nos. 50-254 and 50-265, Directorate of Licensing, Washington, DC, September.

BEA (Bureau of Economic Analysis), 2001. Letter from Richard Kane (BEA) to E. Nicole Hill (TtNUS), containing diskettes on RIMS-II multipliers (Table 1.4), U.S. Department of Commerce, Washington, DC., January 25.

ComEd (Commonwealth Edison Company), 1981. *Supplement to 316(a) and 316(b) Demonstration for Quad Cities Nuclear Generating Station*, Chicago, IL, March.

IEEE (Institute of Electrical and Electronics Engineers), 1997. *National Electrical Safety Code*, 1997 Edition, New York, NY.

IEPA (Illinois Environmental Protection Agency), 2001. Letter from Thomas G. McSwiggin, IEPA, to Exelon Generation Company, LLC, regarding modification of NPDES permit IL005037, December 17.

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

Open Cycle Agreement, 1983. Illinois et al vs. Commonwealth Edison Company et al., District of Columbia, October 11.

Chapter 4

Environmental Consequences of the Proposed Action and Mitigating Actions

NRC

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

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

The environmental report shall discuss the "...impact of the proposed action on the environment. Impacts shall be discussed in proportion to their significance...." 10 CFR 51.45(b)(1) as adopted by 10 CFR 51.53(c)(2)

"The information submitted...should not be confined to information supporting the proposed action but should also include adverse information...." 10 CFR 51.45(e) as adopted by 10 CFR 51.53(c)(2)

Chapter 4 presents an assessment of the environmental consequences and potential mitigating actions associated with the renewal of the QCNPS operating license. The assessment tiers from NRC's *Generic Environmental Impact Statement for License Renewal of Nuclear Plants* (GEIS) (NRC 1996), which identified and analyzed 92 environmental issues that NRC considered to be associated with nuclear power plant license renewal. In its analysis, NRC designated each of the 92 issues as Category 1, Category 2, or NA (not applicable) and required plant-specific analysis of only the Category 2 issues.

NRC designated an issue as Category 1 if, based on the result of its analysis, the following criteria were met:

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

NRC rules do not require analyses of Category 1 issues because NRC resolved them using generic findings presented in 10 CFR 51, Appendix B, Table B-1. An applicant may reference the generic findings or GEIS analyses for Category 1 issues.

If the NRC analysis concluded that one or more of the Category 1 criteria could not be met, the issue was assigned as Category 2. NRC requires plant-specific analyses for Category 2 issues. NRC designated two issues as "NA" (Issues 60 and 92), signifying that the categorization and impact definitions do not apply to these issues. Appendix A of this report lists the 92 issues and identifies the environmental report section that addresses each issue.

Category 1 License Renewal Issues

NRC

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

"...Absent new and significant information, the analysis for certain impacts codified by this rulemaking need only be incorporated by reference in an applicant's environmental report for license renewal...." (NRC 1996).

EGC has determined that, of the 69 Category 1 issues, 14 do not apply to QCNPS because they apply to design or operational features that do not exist at the facility. In addition, because EGC does not plan to conduct any refurbishment activities, the NRC findings for the seven Category 1 issues that pertain only to refurbishment do not apply to this application. Table 4-1 lists these 21 issues and explains EGC's basis for determining that these issues are not applicable to QCNPS.

Table 4-2 lists the 48 Category 1 issues that EGC has determined to be applicable to QCNPS (plus the two "NA" issues for which NRC came to no generic conclusion). The table includes the findings that NRC codified and references to the supporting GEIS analysis. EGC has reviewed the NRC findings and has identified no new and significant information that would make the NRC findings inapplicable to QCNPS. Therefore, EGC adopts by reference the NRC findings for these Category 1 issues.

Category 2 License Renewal Issues

NRC

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

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

NRC designated 21 issues as Category 2. Sections 4.1 through 4.20 address each of these issues, beginning with a statement of the issue. As is the case with Category 1 issues, some Category 2 issues apply to operational features that QCNPS does not have. In addition, some Category 2 issues apply only to refurbishment activities. If an issue does not apply to QCNPS, the section explains the basis for inapplicability.

For the 13 Category 2 issues that EGC has determined to be applicable to QCNPS, analyses are provided. These analyses include conclusions regarding the significance of the impacts relative to the renewal of the operating license for QCNPS and, when applicable, discuss potential mitigative alternatives to the extent required. EGC has identified the significance of the impacts associated with each issue as either Small, Moderate, or Large, consistent with the criteria that NRC established in 10 CFR 51, Appendix B, Table B-1, Footnote 3 as follows:

> SMALL - Environmental effects are not detectable or are so minor that they will neither destabilize nor noticeably alter any important attribute of the resource. For the purposes of assessing radiological impacts, the Commission has concluded that those impacts that do not exceed permissible levels in the Commission's regulations are considered small.
>
> MODERATE - Environmental effects are sufficient to alter noticeably, but not to destabilize, any important attribute of the resource.
>
> LARGE - Environmental effects are clearly noticeable and are sufficient to destabilize any important attributes of the resource.

In accordance with National Environmental Policy Act practice, EGC considered ongoing and potential additional mitigation in proportion to the significance of the impact to be addressed (i.e., impacts that are small receive less mitigative consideration than impacts that are large).

"NA" License Renewal Issues

NRC determined that its categorization and impact-finding definitions were not applicable (NA) to two issues (Issues 60 and 92); however, EGC included these issues in Table 4-2. Applicants currently do not need to submit information on chronic effects from electromagnetic fields (10 CFR 51, Appendix B, Table B-1, Footnote 5). For environmental justice, NRC does not require information from applicants, but noted that it will be addressed in individual license renewal reviews (10 CFR 51,

Appendix B, Table B-1, Footnote 6). EGC has included minority and low-income demographic information in Section 2.6.2.

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

NRC

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

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

As discussed in Section 3.1.2, QCNPS uses a once-through cooling water system that withdraws water from and discharges directly to the Mississippi River and does not utilize cooling water towers or ponds. Therefore, this issue is not applicable.

4.2 Entrainment of Fish and Shellfish in Early Life Stages

NRC

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

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

NRC made impacts on fish and shellfish resources resulting from entrainment a Category 2 issue, because it could not assign a single significance level (small, moderate, or large) to the issue. The impacts of entrainment are small at many plants, but they may be moderate or large at others. Also, ongoing restoration efforts may increase the number of fish susceptible to intake effects during the license renewal period (NRC 1996). Information needed to address this issue includes: (1) the type of cooling system (whether once-through or cooling pond), and (2) the current Clean Water Act (CWA) Section 316(b) determination or equivalent state documentation.

As Section 3.1.2 describes, QCNPS has a once-through heat dissipation system that draws from and discharges to the Mississippi River.

Section 316(b) of the CWA requires that any standard established pursuant to Sections 301 or 306 of the CWA shall require that the location, design, construction, and capacity of cooling water intake structures reflect the best technology available for minimizing adverse environmental impacts (33 USC 1326). Entrainment through the condenser cooling system of fish and shellfish in early life stages is a potential adverse environmental impact that can be minimized by the best available technology.

QCNPS submitted its original Section 316(b) Demonstration to the U.S. Environmental Protection Agency (EPA) in April 1975 (ComEd 1975). In October 1977, Region 5 of the EPA delegated authority to the State of Illinois to manage the State's National Pollutant Discharge Elimination System (NPDES) program. A Supplement to the 316(b) Demonstration that incorporated several additional years of monitoring and examined potential impacts of (full) open-cycle operation was submitted to the Illinois EPA in March 1981 (ComEd 1981).

The current NPDES permit for QCNPS (NPDES Permit No. IL0005037) notes that:

> "Commonwealth Edison Company's demonstration for the Quad Cities Nuclear Power Station in accordance with Section 316(a) and 316(b) of the Clean Water Act was approved by IEPA by letter dated July 28, 1981 and by the Iowa Department of Environmental Quality by letter dated May 18, 1981."

Thus, the current NPDES permit for QCNPS, which was issued by the Illinois EPA on May 26, 2000, and expires on May 31, 2005, constitutes the Station's CWA Section 316(b) determination. This NPDES permit is included as Appendix B.

As noted in Section 2.2, EGC has monitored the fish community of Pool 14 since 1971 and has conducted a variety of studies designed to detect possible impacts of QCNPS operation. There have been no measurable changes in the local fishery and no indications that entrainment has had a destabilizing impact on fish populations. Naturally occurring environmental perturbations (e.g., droughts, floods, and severe winters) appear to influence fish populations more than Station operations. EGC concludes that impacts to fish and shellfish from entrainment are small, and do not impact the overall fish community in Pool 14. Therefore, no additional mitigation is required.

4.3 Impingement of Fish and Shellfish

NRC

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

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

NRC made impacts on fish and shellfish resources resulting from impingement a Category 2 issue, because it could not assign a single significance level to the issue. Impingement impacts are small at many plants, but might be moderate or large at other plants (NRC 1996). Information needed to address this issue includes: (1) the type of cooling system (whether once-through or cooling pond), and (2) the current CWA 316(b) determination or equivalent state documentation.

As discussed in Section 4.2, ComEd submitted a supplemental CWA Section 316(b) Demonstration in 1981 that evaluated impingement at QCNPS and concluded that "losses due to impingement...are minimal."

The current NPDES permit for QCNPS (No. IL0005037) notes that the Section 316(b) Demonstration was approved by the Iowa Department of Environmental Quality on May 18, 1981, and by the Illinois EPA on July 28, 1981. The NPDES permit includes, as Special Condition 10(A), the stipulation that:

> "The permittee shall monitor fish impingement once per week, year round. Each year's data shall be tabulated and compared to historical fish impingement data for the same period with the results submitted to IEPA Permit Section and Compliance Assurance Section by July 28, each year."

The Illinois EPA evaluates these impingement data annually and examines longer term trends in impingement as part of the NPDES renewal process every five years. As noted in Section 4.2, the current NPDES permit for QCNPS, which was issued by the Illinois EPA on May 26, 2000 and expires on May 31, 2005 constitutes the Station's CWA Section 316(b) determination. It is provided as Appendix B.

EGC's monitoring of the fish community of Pool 14 has revealed no measurable changes in the local fishery and no indications that impingement has had a destabilizing impact on fish populations. Naturally occurring environmental perturbations (e.g., droughts, floods, and severe winters) appear to influence fish populations more than Station operations. EGC concludes that impacts to fish and shellfish from impingement are small, and no mitigation is warranted.

4.4 Heat Shock

NRC

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

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

NRC made impacts on fish and shellfish resources resulting from heat shock a Category 2 issue, because of continuing concerns about thermal discharge effects and the possible need to modify thermal discharges in the future in response to changing environmental conditions (NRC 1996). Information needed to address this issue includes: (1) the type of cooling system (whether once-through or cooling pond), and (2) the evidence of a CWA Section 316(a) variance or equivalent state documentation.

As Section 3.1.2 describes, QCNPS has a once-through heat dissipation system that withdraws from and discharges to the Mississippi River. As discussed in Section 4.2, ComEd's Section 316(a) Demonstration for QCNPS was approved by the Illinois EPA and the Iowa Department of Environmental Quality in 1981.

The NPDES permit for QCNPS provides for a mixing zone, but does not allow the Station to exceed State water quality standards for temperatures outside of the mixing zone. To ensure compliance with State of Illinois water quality standards, the NPDES permit for QCNPS contains monthly maximum temperature limits for "representative locations in the main river" at the edge of the designated mixing zone, a maximum temperature increase (5°F) above "natural temperature" at the edge of the mixing zone, and restrictions on the size of the thermal mixing zone.

Based on historic field studies that determined the effect of full-power operation and varying river flow rates on downstream water temperatures (the "temperature monitoring curve"), QCNPS is able to calculate a plant load that allows the Station to stay within NPDES permit limits for discharge temperature. When NPDES permit limits for temperature are approached at the mixing zone boundary, the temperature monitoring curve provides a means to calculate permissible plant load as a function of river flow.

The NPDES permit for QCNPS also contains specific requirements for daily continuous monitoring of Station circulating water flows, daily continuous monitoring of discharge temperatures, weekly determination of river flow rate, daily monitoring of the ambient temperature of the river, daily determination of Station load (percent power), and (as warranted) daily determination of the temperature at a river

cross-section 500 feet downstream from the Station's diffuser system. This extensive monitoring program allows QCNPS operating personnel to respond quickly to changing conditions in the river and adjust power levels as needed to ensure compliance with NPDES temperature limits.

QCNPS is able to operate at full power in the open-cycle mode while still meeting State water temperature standards under most river flow conditions (ComEd 1981). Under low flow conditions, QCNPS must sometimes reduce power levels to ensure that NPDES permit temperature limits are not exceeded. Under normal circumstances, QCNPS meets State water quality (temperature) standards. Therefore, it has not sought a 316(a) variance in accordance with 40 CFR 125. Because it has an approved 316(a) Demonstration and an NPDES permit that requires conformance with State water temperature standards, EGC concludes that heat shock impacts are small and no further mitigation is necessary.

4.5 Groundwater Use Conflicts (Plants Using > 100 gpm of Groundwater)

NRC

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

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

NRC made groundwater use conflicts a Category 2 issue because, at a withdrawal rate of more than 100 gallons per minute (gpm), a cone of depression could extend offsite. This could deplete the groundwater supply available to offsite users, an impact that could warrant mitigation. Information needed to address this issue includes: (1) the QCNPS groundwater withdrawal rate (whether greater than 100 gpm), (2) the drawdown at offsite location, and (3) impact on neighboring wells.

Based on information presented in Section 3.1.2, QCNPS' groundwater use has averaged 717 gallons per minute over the last 10 years and, therefore, the issue of groundwater use conflicts does apply. In 1997, groundwater was used to heat the water in the fish rearing facility used at the Station to grow and release fish to the Mississippi River. During this period, groundwater use from Well 7 was six times normal use. Without this period of high use, the 10-year average yield for the site is approximately 418 gallons per minute and the issue would still apply.

During periods of pumping, groundwater levels in site wells are monitored by EGC to determine whether drawdown is taking place that might impact offsite groundwater users. EGC has not observed a lowering of water levels in site wells during monitoring. Therefore, groundwater use conflict impacts would be small, if any, and mitigation measures would not be warranted.

4.6 Groundwater Use Conflicts (Plants Using Cooling Towers or Cooling Ponds that Withdraw Makeup Water from a Small River)

NRC

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

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

QCNPS does not use cooling ponds or cooling towers. As Section 3.1.2 describes, QCNPS uses a once-through cooling water system that withdraws from and discharges directly to the Mississippi River. Therefore, the issue of groundwater use conflicts due to river water makeup does not apply to QCNPS.

4.7 Groundwater Use Conflicts (Plants Using Ranney Wells)

NRC

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

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

The issue of groundwater use conflicts does not apply to QCNPS because the Station does not use Ranney wells. As Section 3.1.2 describes, QCNPS withdraws water from and discharges directly to the Mississippi River.

4.8 Degradation of Groundwater Quality

NRC

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

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

The issue of groundwater degradation does not apply to QCNPS because the Station does not use a cooling water pond. As Section 3.1.2 describes, QCNPS employs a once-through cooling system, withdrawing river water from and discharging directly to the Mississippi River.

4.9 Impacts of Refurbishment on Terrestrial Resources

NRC

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

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

"...If no important resources would be affected, the impacts would be considered minor and of small significance. If important resources could be affected by refurbishment activities, the impacts would be potentially significant...." (NRC 1996, Section 3.6, pg. 3-6)

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

4.10 Threatened or Endangered Species

NRC

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

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

NRC made impacts to threatened and endangered species a Category 2 issue because the status of many species is being reviewed, and site-specific assessment is required to determine whether any identified species could be affected by refurbishment activities or continued plant operations through the renewal period. In addition, compliance with the Endangered Species Act requires consultation with the appropriate federal agency (NRC 1996).

Section 2.4 discusses ecological habitats at QCNPS and along associated transmission lines. Section 2.5 discusses threatened or endangered terrestrial and aquatic species that may occur at QCNPS or along associated transmission lines. As discussed in Section 3.2, EGC has no plans to conduct refurbishment or construction at QCNPS during the license renewal period. Therefore, there would be no refurbishment-related impacts to threatened or endangered species, and no further analysis of refurbishment-related impacts is applicable.

EGC has corresponded with the states of Illinois and Iowa and the U.S. Fish and Wildlife Service regarding the presence of threatened or endangered species in the project area and potential impacts to those species. Copies of this correspondence is provided in Appendix C.

EGC is aware of no resident threatened or endangered terrestrial species being present at QCNPS or along the associated transmission corridors. The presence of transient species is possible, but EGC is aware of no QCNPS or transmission line activities that would adversely impact transient species. EGC has no plans for the license renewal term that would alter the conclusion that QCNPS has no adverse impacts on threatened or endangered species.

The Higgins' eye pearly mussel (*Lampsilis higgensi*), a federally endangered species, is found in Pool 14 of the Mississippi River upstream and downstream of QCNPS, with highest densities in the vicinity of Cordova, Illinois, 1.5 to 3.5 miles downstream of the Station (River Mile [RM] 505.5 to RM 503.0; see Section 2.5). The reach of the river from RM 505.5 to RM 503.0 has been designated an Essential Habitat Area in the U.S. Fish and Wildlife Service's (draft) Recovery Plan for the species, based on the fact that a reproducing population is present in association with a healthy and diverse unionid community where more than 30 unionid species are believed to be present. This suggests that operation of QCNPS since 1971 has not adversely affected the Higgins' eye pearly mussel population. In

addition, the Station's discharges (thermal and otherwise) are closely monitored under the NPDES program and permit limits are reviewed on a regular basis by state regulatory agencies to ensure the protection of aquatic biota, including freshwater mussels (Section 4.4). Available evidence suggests that nearly 30 years of Station operation have not adversely affected this species, nor will operation over the license renewal term.

EGC has no plans to alter current operations. Resource agencies contacted by EGC have not identified any serious concerns about license renewal impacts. Therefore, EGC concludes that impacts of license renewal to threatened or endangered species would be small and do not warrant mitigation.

4.11 Air Quality During Refurbishment (Non-Attainment and Maintenance Areas)

NRC

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

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

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

4.12 Impact on Public Health of Microbiological Organisms

NRC

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

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

NRC designated impacts on public health from thermophilic organisms a Category 2 issue because NRC did not have sufficient data available for facilities using cooling ponds, lakes, or canals that discharge to small rivers. Information needed to address this issue is: (1) whether the plant discharges to a small river, and (2) whether discharge characteristics (particularly temperature) are conducive to thermophilic organism survival in public waters.

This issue is applicable to QCNPS because the average annual flow of the Mississippi River at the Station is 50,500 cubic feet per second (1.6 × 10^{12} cubic feet per year), which is less than the 3.15 × 10^{12} cubic feet per year threshold value [10 CFR 51.53(c)(3)(ii)(G)].

Organisms of concern include the enteric pathogens *Salmonella* and *Shigella*, the *Pseudomonas aeruginosa* bacterium, thermophilic Actinomycetes ("fungi"), the many species of *Legionella* bacteria, and pathogenic strains of the free-living *Naegleria* amoeba.

Pathogenic bacteria have evolved to survive in the digestive tracts of mammals and, accordingly, have optimum temperatures of around 99 degrees Fahrenheit (°F) (Joklik and Smith 1972). Many of these pathogenic microorganisms (e.g., *Pseudomonas*, *Salmonella*, and *Shigella*) are ubiquitous in nature, occurring in the digestive tracts of wild mammals and birds (and thus in natural waters), but are usually only a problem when the host is immunologically compromised. Thermophilic bacteria generally occur at temperatures of 77°F to 176°F, with maximum growth at 122°F to 140°F (Joklik and Smith 1972).

QCNPS monitors water temperature and other parameters at the Open Cycle Diffusers in the Mississippi River as required by the Station's NPDES permit. Temperature measurements are taken daily and maximum values are reported monthly to the Illinois EPA. Based on plant discharge monitoring reports, the maximum discharge temperature observed from January 1999 through September 2001 was 111.6°F, which occurred in late July 2001.

Maximum temperatures in the Mississippi River near the Open Cycle Diffusers are generally below the optimal temperature range for growth and reproduction of thermophilic microorganisms. They could support limited survival of these organisms in summer months, although temperatures are generally below the range most conducive to the growth of thermophilic microorganisms.

Another factor controlling the survival and growth of thermophilic organisms in the Mississippi River is the disinfection of QCNPS sanitary waste treatment plant effluent. This reduces the likelihood that a seed source or inoculant will be introduced into the Station's discharge.

Fecal coliform bacteria are regarded as indicators of other pathogenic microorganisms, and are the organisms normally monitored by state health agencies. The NPDES permit for the Station requires monitoring of fecal coliforms in sewage treatment plant effluent. Samples are collected for fecal coliform analysis and other parameters twice per month. The NPDES permit specifies a daily maximum of 400 organisms per 100 milliliters of sample (400/100 ml). From January 1999 through September 2001, the maximum fecal coliform count recorded was 17 per 100 milliliters.

It should also be noted that waterborne-disease outbreaks are generally rare and depend upon specific exposure conditions. The Centers for Disease Control and Prevention reports on waterborne-disease outbreaks throughout the United States. From 1977 to 1998, a total of 18 states reported 32 outbreaks associated with recreational water, which includes both thermophilic and non-thermophilic micro-organisms as confirmed etiological agents (CDC 2000). Most of the outbreaks associated with thermophilic micro-organisms involved swimming and wading pools, hot tubs, and springs. Fecal contamination was frequently a contributing factor. In 1998, only four cases of disease attributable to *Naegleria* were confirmed in the entire United States (CDC 2000), none associated with power plant effluents.

Naegleria infection usually only occurs in warm weather environments, when water near the bottom of a lake is forced up the nasal passage of a swimmer, and when pollution appears to be a factor (EPA 1979). However, studies have shown the absence of *Naegleria* infection and related disease among swimmers in lakes with high numbers of the pathogenic organism present (EPA 1979). The Open Cycle Diffusers for QCNPS are located at the bottom of the Mississippi River in a shipping channel, an area that is avoided by recreational users. The likelihood of exposure to potentially contaminated waters by recreational or commercial users would be extremely low.

Given the thermal characteristics of the Mississippi River in the vicinity of the Open Cycle Diffusers and the disinfection of sewage treatment plant effluent, QCNPS operations will not stimulate growth or reproduction of thermophilic micro-organisms. Under certain circumstances these organisms might be present in limited numbers near the Open Cycle Diffusers, but would not be in sufficient concentrations to pose a threat to human receptors, especially given the lack of potential exposure for human receptors.

EGC has written the Illinois Department of Public Health, the Illinois Environmental Protection Agency, and the Iowa Department of Public Health requesting information on any studies the agencies or their contractors might have conducted of thermophilic microorganisms in the Mississippi River in the vicinity of QCNPS, and any concerns they might have relative to these organisms. Based on agency responses and the discussion in this section, EGC concludes that the impact of microbiological organisms is small and does not warrant mitigation. Copies of the consultation letters and agency responses are included in Appendix D of this environmental report.

4.13 Electromagnetic Fields – Acute Effects

NRC

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

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

NRC made impacts of electric shock from transmission lines a Category 2 issue because, without a review of each plant's transmission line conformance with the National Electrical Safety Code (NESC) (IEEE 1997) criteria, NRC could not determine the significance of the electrical shock potential.

In the case of QCNPS, there have been no previous NRC or National Environmental Policy Act analyses of transmission-line-induced-current hazard. Therefore, this section provides an analysis of the Station's transmission lines' conformance with the NESC standard. The analysis is based on computer modeling of induced current under the lines.

Objects near transmission lines can become electrically charged due to their immersion in the lines' electric field. This charge results in a current that flows through the object to the ground. The current is called "induced" because there is no direct connection between the line and the object. The induced current can also flow to the ground through the body of a person who touches the object. An object that is insulated from the ground can actually store an electrical charge, becoming what is called "capacitively charged." A person standing on the ground and touching a vehicle or a fence receives an electrical shock due to the discharge of the capacitive charge through the person's body to the ground. After the initial discharge, a steady-state current can develop of which the magnitude depends on several factors, including the following:

- the strength of the electric field which, in turn, depends on the voltage of the transmission line as well as its height and geometry
- the size of the charged object on the ground
- the extent to which the object is grounded.

In 1977, the NESC adopted a provision that describes an additional criterion to establish minimum vertical clearances to the ground for electric lines having voltages exceeding 98-kilovolt (kV) alternating current to ground.[1] The clearance must limit the

[1] Part 2, Rules 232C1c and 232D3c.

steady-state induced current[2] to 5 milliamperes if the largest anticipated truck, vehicle, or equipment were short-circuited to ground. By way of comparison, the setting of ground fault circuit interrupters used in residential wiring (special breakers for outside circuits or those with outlets around water pipes) is 4 to 6 milliamperes.

As described in Section 3.1.3, there are five 345-kV lines that were specifically constructed to distribute power from QCNPS to the electric grid. EGC's analysis of these transmission lines began by identifying the limiting case for each line. The limiting case is the configuration along each line where the potential for current-induced shock would be greatest. Once the limiting case was identified, EGC calculated the electric field strength for each transmission line, then calculated the induced current.

EGC calculated electric field strength and induced current using a computer code called AC/DCLINE, produced by the Electric Power Research Institute (EPRI 1992). The results of this computer program have been field-verified through actual electric field measurements by several utilities. The input parameters included design features of the limiting-case scenario, the NESC requirement that line sag be determined at 120 degrees Fahrenheit conductor temperature, and the maximum vehicle size under the lines as a tractor-trailer truck.

The analysis determined that two of the five transmission lines have the capacity to induce more than 5 milliamperes in a tractor-trailer parked beneath the lines. However, one exceedance was only 5.4 milliamperes. Given that the NESC limit is specified to only one significant digit, EGC believes that this line (with induced current of 5 milliamperes to one significant digit) is in nominal compliance. The other exceedance was 6 milliamperes. The location is a county road near QCNPS that would have very infrequent large truck traffic. Therefore, four QCNPS transmission lines conform to the NESC provisions for preventing electric shock from induced current and one exceeds the limit. The results for each transmission line are provided in Table 4-3. Details of the analysis, including the input parameters for each line's limiting case, can be found in TtNUS (2001).

ComEd, Alliant Energy, and MidAmerican Energy, the lines' owners, conduct surveillance and maintenance to assure that design ground clearances will not change. These procedures include routine airplane inspection on a regular basis. The aerial patrols of all corridors include checks for encroachments, broken conductors, broken or leaning structures, and signs of trees burning, any of which would be evidence of clearance problems. Ground inspections include examination for clearance at questionable locations, integrity of structures, and surveillance for dead or diseased trees that might fall on the transmission lines. Problems noted during any inspection are brought to the attention of the appropriate organizations for corrective action.

EGC's assessment under 10 CFR 51 concludes that electric shock is of small significance for the QCNPS transmission lines because (1) the exceedance is small (6 milliamperes) and would occur very infrequently, (2) the transmission lines would continue to be used regardless of license renewal, and (3) the proposed action has no effect on the current status of the lines. Mitigation measures such as installing warning signs at road crossings or increasing clearances are not warranted, because the exceedance is small and within the error of the calculation. This conclusion would remain valid into the future, provided there are no changes in line use, voltage,

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

current, and maintenance practices and no changes in land use under the lines.

4.14 Housing Impacts

NRC

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

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

"...[S]mall impacts result when no discernible change in housing availability occurs, changes in rental rates and housing values are similar to those occurring statewide, and no housing construction or conversion occurs." (NRC 1996, Section 4.7.1).

NRC made housing impacts a Category 2 issue, because impact magnitude depends on local conditions that NRC could not predict for all plants at the time of GEIS publication (NRC 1996). Local information needed to address this issue includes: (1) population categorization as small, medium, or high, and (2) applicability of growth control measures. As used in the GEIS, "growth control measures" constitute institutional controls that would limit the market's ability to meet a demand for additional housing.

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

As described in Section 2.6.1, QCNPS is located in a medium population area. As noted in Section 2.9, the area of interest is not subject to growth control measures that limit housing development. In 10 CFR 51, Subpart A, Appendix B, Table B-1, NRC concluded that impacts to housing are expected to be of small significance at plants located in "medium" population areas where growth control measures are not in effect. Therefore, EGC concludes housing impacts to be small.

This conclusion is supported by the following site-specific housing analysis. The maximum impact to area housing is calculated using the following assumptions: (1) all direct and indirect jobs would be filled by in-migrating residents; (2) the residential distribution of new residents would be similar to current worker distribution; and (3) each new job created (direct and indirect) represents one housing unit. As described in Section 3.4, approximately 77 percent of the QCNPS employees reside

in Rock Island and Whiteside Counties (Illinois) or in Scott County (Iowa). Therefore, the focus of the housing impact analysis is on these counties. As also discussed in Section 3.4, EGC conservatively assumes 60 license renewal employees could generate the demand for 199 housing units (60 direct and 139 indirect jobs). If it is assumed that 77 percent of the 199 new workers would locate in one of the three counties, consistent with current employee residential patterns, approximately 153 housing units would be required in Rock Is land, Whiteside, and Scott Counties. In an area which has a population exceeding 368,000 (Section 2.6), this demand would not create a discernible change in housing availability, rental rates or housing values, or spur housing construction or conversion. EGC concludes that impacts to housing availability resulting from Station-related population growth would be small and would not warrant mitigation.

4.15 Public Utilities: Public Water Supply Availability

NRC

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

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

"Impacts on public utility services are considered small if little or no change occurs in the ability to respond to the level of demand and thus there is no need to add capital facilities. Impacts are considered moderate if overtaxing of facilities during peak demand periods occurs. Impacts are considered large if existing service levels (such as quality of water and sewage treatment) are substantially degraded and additional capacity is needed to meet ongoing demands for services." (NRC 1996, Section 3.7.4.5).

NRC made public utility impacts a Category 2 issue because an increased problem with water availability, resulting from pre-existing water shortages, could occur in conjunction with plant demand and plant-related population growth (NRC 1996). Local information needed to address this issue includes: (1) a description of water shortages experienced in the area, and (2) an assessment of the public water supply system's available capacity.

The NRC's analysis of impacts to the public water supply system considered both plant demand and plant-related population growth demands on local water resources. Section 3.4 describes potential population increases, and Section 2.6 describes the distribution of that population in the area associated with license renewal activities at QCNPS. Section 2.10.1 describes the public water supply systems potentially affected by license renewal activities, their permitted capacities, and current demands. QCNPS does not use water from a municipal system; therefore, EGC concludes QCNPS will have no effect on local water supplies. As discussed in Section 3.2, no refurbishment is planned for QCNPS and no refurbishment impacts are therefore expected.

The impact to the local water supply systems resulting from plant-related population growth can be determined by calculating the amount of water that would be required by these individuals. The average American uses between 50 and 80 gallons per day for personal use (Fetter 1980). As described in Section 3.4, EGC's conservative assumption of 60 license renewal employees could generate 199 new jobs. If the distribution of these jobs follows current employee trends (see Section 2.6.1), this would place 106 new employees in Rock Island and Whiteside County, Illinois (53.5 percent of 199 jobs) and 47 additional employees in Scott County, Iowa (23.5 percent of 199 jobs). This could result in a population increase of 281 in Rock Island and Whiteside County (106 jobs multiplied by 2.65, which is the average number of persons per household in Illinois) and 118 in Scott County (47 jobs multiplied by 2.50, which is the average number of persons per household in Iowa) (USBC 1999). Using the average consumption rate, the plant-related

population increase would require an additional 31,920 gallons per day (399 people multiplied by 80 gallons per day). If it is assumed that this increase is distributed across the three potentially affected counties, the increase in water demand would represent an insignificant percentage of capacity for the water supply systems in these counties. (See Section 2.10.1 for a discussion of the current capacities of these systems.) EGC concludes that impacts resulting from Station-related population growth to public water supplies would be small, requiring no additional capacity and not warranting mitigation.

4.16 Education Impacts from Refurbishment

NRC

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

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

"...[S]mall impacts are associated with project-related enrollment increases of 3 percent or less. Impacts are considered small if there is no change in the school systems' abilities to provide educational services and if no additional teaching staff or classroom space is needed. Moderate impacts generally are associated with 4 to 8 percent increases in enrollment. Impacts are considered moderate if a school system must increase its teaching staff or classroom space even slightly to preserve its pre-project level of service.... Large impacts are associated with project-related enrollment increases greater than 8 percent...." (NRC 1996, Section 3.7.4.1).

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

4.17 Offsite Land Use

4.17.1 REFURBISHMENT

NRC

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

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

"...[I]f plant-related population growth is less than 5 percent of the study area's total population, off-site land-use changes would be small, especially if the study area has established patterns of residential and commercial development, a population density of at least 60 persons per square mile, and at least one urban area with a population of 100,000 or more within 50 miles...." (NRC 1996, Section 3.7.5).

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

4.17.2 LICENSE RENEWAL TERM

NRC

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

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

"...[I]f plant-related population growth is less than five percent of the study area's total population, off-site land-use changes would be small...." (NRC 1996, Section 3.7.5)

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

NRC made impacts to offsite land use during the license renewal term a Category 2 issue, because land-use changes may be perceived as beneficial by some community members and adverse by others. Therefore, NRC could not assess the potential significance of site-specific offsite land-use impacts (NRC 1996). Site-specific factors to consider in an assessment of new tax-driven land-use impacts include: (1) the size of plant-related population growth compared to the area's total population, (2) the size of the plant's tax payments relative to the community's total revenue, (3) the nature of the community's existing land-use pattern, and (4) the extent to which the community already has public services in place to support and guide development.

The GEIS presents an analysis of offsite land use for the renewal term that is characterized by population-driven and tax-driven impacts (NRC 1996).

Population-Driven-Related Impacts

Based on the GEIS case-study analysis, NRC concludes that all new population-driven land-use changes during the license renewal term at all nuclear plants would be small. Population growth caused by license renewal would represent a much smaller "percentage of the local areas" total population than the percentage presented by operations-related growth (NRC 1996).

Tax-Revenue-Related Impacts

NRC has determined that the significance of tax payments as a source of local government revenue would be small, if the payments are less than five percent of revenue (NRC 1996).

NRC further determined that, if the plant's tax payments are projected to be small relative to the community's total revenue, new tax-driven land-use changes during the

plant's license renewal term would be small, especially where the community has pre-established patterns of development and has provided adequate public services to support and guide development.

NRC defined the magnitude of land-use changes as follows (NRC 1996):

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

Table 2-4 provides a comparison of the total tax payments made by EGC to Rock Island County, the County's extended levees, and the collections available for distribution to the districts. For the 3-year period from 1997 through 1999, EGC's tax payments to Rock Island County represented approximately 2.8 percent of the County's collections available for distribution. Using NRC's criteria, EGC's tax payments are of small significance to Rock Island County. As described in Section 3.2, EGC does not anticipate refurbishment or construction during the license renewal period. Therefore, EGC does not anticipate any increase in the assessed value of QCNPS due to refurbishment-related improvements nor any related tax-increase-driven changes to offsite land use and development patterns.

EGC does not anticipate large land-use changes as a result of current or future tax assessments. Despite the positive impact created by QCNPS tax payments to Rock Island County, QCNPS has not been a dominant source of tax revenues. Additionally, current tax payment amounts are expected to decline significantly due to deregulation of the utility industry. Ongoing negotiations between EGC and Rock Island County will reflect taxes based upon fair market values of the Station, as opposed to depreciated book values of the facility. Based on current market conditions, future tax payments are predicted to be markedly less. Rock Island County has experienced a measure of land-use change, but nothing significantly different from the changes caused by the decline in the agriculture industry. EGC believes that the continued operation of QCNPS would be an important contributor to the maintenance of current levels of local development and public services, and does not anticipate plant-induced changes to local land-use or development patterns as a result of license renewal.

Conclusion

Exelon views the continued operation of QCNPS as a benefit to Rock Island County through its direct and indirect salaries and tax contributions to the County's economy. Because population growth related to the license renewal of QCNPS is expected to be relatively small and because there would be no license-renewal-related tax impacts to Rock Island County land use, EGC concludes that the renewal of QCNPS licenses would have a continued small, yet beneficial, impact on Rock Island County.

4.18 Transportation

NRC

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

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

"Small impacts would be associated with a free flowing traffic stream where users are unaffected by the presence of other users (level of service A) or stable flow in which the freedom to select speed is unaffected but the freedom to maneuver is slightly diminished (level of service B)." (NRC 1996, Section 3.7.4)

NRC made impacts to transportation a Category 2 issue, because impact significance is determined primarily by road conditions existing at the time of the project, which NRC could not forecast for all facilities (NRC 1996). Local road conditions needed to address this issue include: (1) the level of service conditions, and (2) the incremental increases in traffic associated with refurbishment activities and license renewal staff.

As described in Section 3.2, no major refurbishment is planned and no refurbishment impacts to local transportation are therefore anticipated.

EGC's QCNPS workforce includes approximately 850 permanent and 130 contract employees. Approximately once every 24 months, approximately 1,100 additional workers join the permanent workforce for two refueling outages, one for each unit. Each unit will be refueled on a 24-month cycle. EGC's conservative assumption of 60 additional employees associated with license renewal for QCNPS represents a 6.1 percent increase in the current number of employees (permanent and contract) and an even smaller percentage of employees present onsite during the annual refueling outages. Given these employment projections and the average number of vehicles per day currently using the surrounding roads to QCNPS (Table 2-8), EGC concludes that impacts to transportation would be small and mitigative measures would be unwarranted.

4.19 Historic and Archaeological Resources

NRC

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

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

"Sites are considered to have small impacts to historic and archaeological resources if (1) the State Historic Preservation Officer (SHPO) identifies no significant resources on or near the site; or (2) the SHPO identifies (or has previously identified) significant historic resources but determines they would not be affected by plant refurbishment, transmission lines, and license-renewal term operations and there are no complaints from the affected public about altered historic character; and (3) if the conditions associated with moderate impacts do not occur." (NRC 1996)

NRC made impacts to historic and archaeological resources a Category 2 issue because determinations of impacts to historic and archaeological resources are site-specific in nature, and the National Historic Preservation Act mandates that impacts must be determined through consultation with the State Historic Preservation Officer (NRC 1996).

As EGC does not plan any refurbishment activities, no refurbishment-related impacts to historic or archaeological resources are anticipated.

As described in Section 2.12, the Final Environmental Statement (AEC 1972) identified two historic sites in the vicinity of the Station, but not on Station property. ComEd did not perform an archaeological survey prior to site construction. However, ComEd did contract with the Illinois Archeological Survey to conduct a reconnaissance survey of a portion of the spray canal that was under construction in order to determine if any archaeological sites were in the area of the canal and if any previous damage had been done. As described in Section 2.12, the surveyor concluded that there was no evidence of archaeological materials in the area.

EGC has identified current listings of National Historic Register sites of significance within a six-mile radius of the Station. Additionally, EGC contracted with the State Archaeologist of Iowa to do a file survey of the 0401 Davenport transmission line. Staff from this office surveyed the area within a 1-mile radius of the line and discovered the presence of one site, 13ST157, within the corridor. As indicated in Section 2.12, the site is located on land that is regularly disturbed by agricultural activities. Therefore, right-of-way (ROW) maintenance impacts would be considered minimal, if detectable at all, by comparison.

In addition, EGC has consulted with the States of Illinois and Iowa regarding whether any historic or archaeological properties would be impacted by the proposed action. Both states replied that no historical properties would be affected. Copies of the consultation letters and agency responses are included in Appendix E of the environmental report. Based on the results of these inquiries, EGC is currently not aware of any historic or archaeological sites that are being or have been impacted by QCNPS operations, facility, or right-of-way management. EGC does not expect these practices to change as a result of license renewal. Based on the information accumulated at this time, EGC concludes that the continued use of facilities, transmission lines, and rights-of-way is projected to cause little or no impact on historic sites over the license renewal term.

4.20 Severe Accident Mitigation Alternatives (SAMA)

NRC

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

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

The purpose of this subsection is to summarize the SAMA analysis process and results. Appendix F provides a detailed description of the material presented here.

4.20.1 METHODOLOGY

The methodology selected for this analysis involves identifying those SAMA candidates that have the highest potential for reducing core damage frequency and person-rem risk and determining whether or not the implementation of those candidates is beneficial on a cost-risk reduction basis. This process consists of the following steps:

QCNPS Probabilistic Safety Assessment (PSA) Model – use the Quad Cities Nuclear Power Station (QCNPS) PSA model as the basis for the analysis.

Level 3 PSA Analysis – Use QCNPS Level 1 and 2 PSA output and site-specific meteorology, demographic, land use, and emergency response data as input in performing a Level 3 probabilistic safety assessment (PSA) using the MELCOR Accident Consequences Code System Version 2 (MAACS2).

Baseline Risk Monetization – Use NRC regulatory analysis techniques, calculate the monetary value of the unmitigated QCNPS severe accident risk. This becomes the maximum averted cost-risk that is possible.

Phase I SAMA Analysis – Identify potential SAMA candidates based on QCNPS, NRC, and industry documents. Screen out Phase 1 SAMA candidates that are not applicable to the QCNPS design or are of low benefit in boiling water reactors (BWRs) such as QCNPS, candidates that have already been implemented at QCNPS or whose benefits have been achieved at QCNPS using other means, and candidates whose estimated cost exceeds the maximum possible averted cost-risk.

Phase II SAMA Analysis – Calculate the risk reduction attributable to each remaining SAMA candidate and compare to a more detailed cost analysis to identify any net cost benefit. Probabilistic safety assessment (PSA) insights are also used to screen SAMA candidates in this phase.

Uncertainty Analysis – Evaluate how a reduced discount value might affect the cost/benefit analyses.

Conclusions – Summarize results and identify conclusions.

4.20.2 QCNPS PSA MODEL

The 2002 update to the QCNPS PRA is the most recent evaluation of the risk profile at the QCNPS Unit 1 for internal event challenges. It is a periodic update, in accordance with EGC internal guidance, ER-AA-600-1015, "Full Power Internal Events (FPIE) PRA Model Update." There have been a series of probabilistic evaluations beginning with the Individual Plant Examination (IPE) issued in 1993 as requested by the NRC in Generic Letter 88-20.

The baseline CDF is 2.2E-6/yr.

Update Revision 02B includes the following:

- Approximately 17% Extended Power Uprate (EPU) plant configuration and MAAP 4.0.4 analysis
- Revised human reliability analysis (HRA) based on the most recent operator interviews
- Operating event experience review
- Maintenance unavailability data based on the most recent plant operating experience
- Bayesian updated initiating event frequencies utilizing QCNPS most recent operating experience
- Individual component random failure probabilities Bayesian updated (as applicable) based upon the most recent plant specific data and the most current generic sources
- Common cause failure (CCF) calculations revised to incorporate the updated individual random basic event probabilities and the most up to date Multiple Greek Letter (MGL) parameters from NUREG/CR-5497 and NUREG/CR-5485
- Revised LOOP/DLOOP analysis for initiating event frequencies and non-recovery probabilities based upon a Midwest regional data filtering approach
- Revised mechanical and electrical ATWS probabilities, based on information in NUREG/CR-5500
- Response to QCNPS BWROG Peer Review comments using the NEI PRA Peer Review Process (NEI 00-02)
- Response to additional independent Peer Review Comments

The QCNPS PRA model update has been performed with as-built, as-operated information, current as of June 2001. This includes plant-specific initiating event and equipment performance data for the 5-1/2-yr period ending in June 2001.

The documentation to support the PRA Update has been compiled in a set of modularized notebooks to provide the specific information needed for the PRA Update.

4.20.3 QCNPS LEVEL 3 PSA ANALYSIS

4.20.3.1 Analysis

The MACCS2 code (Chanin and Young 1997) was used to perform the level 3 probabilistic risk assessment (PRA) for the QCNPS (QCNPS). The input parameters given with the MACCS2 "Sample Problem A," which included the NUREG-1150 food model (NRC 1989) formed the basis for the present analysis. These generic values were supplemented with parameters specific to QCNPS and the surrounding area. Site-specific data included population distribution, economic parameters, and agricultural production.

Plant-specific release data included the time-nuclide distribution of releases, release frequencies, and release locations. The behavior of the population during a release (evacuation parameters) was based on plant and site-specific set points (i.e., declaration of a General Emergency) and the emergency planning zone (EPZ) evacuation table (ComEd 1994). These data were used in combination with site-specific meteorology to simulate the probability distribution of impact risks (exposure and economic) to the surrounding (within 50 miles) population from the accident sequences at QCNPS.

4.20.3.2 Population

The population surrounding the QCNPS site was estimated for the year 2032. Population projections within 50 miles of QCNPS were determined using a geographic information system (GIS), U.S Census block-group level population data for 2000 allocated to each sector based on the area fraction of the census block-groups in each sector, and populations growth rates estimates for each county. The projected county growth rates were weighted by the fraction of each county in the 50-mile radius. The calculated growth rate of 1.067 from 2000 to 2032 was applied uniformly to all sectors. The distribution was given in terms of population at distances to 1, 2, 3, 4, 5, 10, 20, 30, 40 and 50 miles from the plant and in the direction of each of the 16 compass points (i.e., N, NNE, NE.....NNW). The total year 2032 population for the 160 sectors (10 distances × 16 directions) in the region was estimated as 700,677.

4.20.3.3 Economy

MACCS2 requires the spatial distribution of certain economic data (fraction of land devoted to farming, annual farm sales, fraction of farm sales resulting from dairy production, and property value of farm and non-farm land) in the same manner as the population. This was done by updating the database in the SECPOP90 code (NRC 1997b) for each of the 21 counties surrounding the plant to a distance of 50 miles, using the methodology (NRC 1997b) and data from USBC 2001, USDC 2000, BEA 2000a, BEA 2000b and USDA 1998. The values for up to 97 economic zones allocated to each of the 160 sectors were then calculated using SECPOP90 code with the updated economic and agricultural database.

In addition, generic economic data that are applied to the region as a whole were revised from the MACCS2 sample problem input when better information was available. These revised parameters include per diem living expenses (applied to owners of interdicted properties and relocated populations), relocation costs (for owners of interdicted properties), value of farm and non-farm wealth, and fraction of farm wealth from improvements (e.g., buildings, equipment).

4.20.3.4 Agriculture

Agricultural production information was taken from the 1997 Agricultural Census (USDA 1998). Production within 50 miles of the site was estimated based on those counties within this radius. Production in those counties, which lie partially outside of this area, was multiplied by the fraction of the county within the area of interest. Of the food crops, grain (51 percent of the total cropland, made up of corn and wheat), and legumes (29 percent of the total cropland, made up of soybeans) were harvested from the largest areas. Pasture (13 percent) and stored forage (6 percent of total cropland, consisting of hay) made up most of the remaining harvested cropland.

The lengths of the growing seasons for grains and legumes were obtained from USDA 1997. The duration of the growing season for the remaining crop categories (pasture, stored forage, green leafy vegetables, roots/tubers and other food

crops) were based on reasonable estimates. The uncertainty in these estimates does not have a significant impact due to the much smaller fraction of land dedicated to these crops.

4.20.3.5 Nuclide Release

The core inventory at the time of the accident was based on the input supplied in the MACCS User's Guide (Chanin and Young 1997). The core inventory corresponds to the end-of-cycle values for a 3578 MWth BWR plant. A scaling factor of 0.8264 was used to provide a representative core inventory of 2957-MWth at QCNPS. Each QCNPS category corresponded with a single release duration (either puff or continuous).

All releases were modeled as occurring at ground level. The thermal content of each of the releases was conservatively assumed to be the same as ambient; i.e., buoyant plume rise was not modeled.

4.20.3.6 Evacuation

Scram for each sequence was taken as time zero. A General Emergency is declared when plant conditions degrade to the point where it is judged that there is a credible risk to the public.

The MACCS2 User's Guide input parameters of 95 percent of the population within 10 miles of the plant (Emergency Planning Zone) evacuating and 5 percent not evacuating were employed. These values have been used in similar studies (e.g., Hatch (SNC 2000), Calvert Cliffs (NRC 1999), and are conservative relative to the NUREG-1150 study, which assumed evacuation of 99.5 percent of the population within the emergency planning zone (NRC 1989a). The evacuees are assumed to begin evacuation 15 minutes (ComEd 1994) after a General Emergency has been declared and are evacuated at an average radial speed of 2.4 miles per hour (1.07 m/sec). This speed is calculated from the maximum evacuation time of 250 minutes from the full 0-10mi. EPZ under daytime adverse weather conditions, and includes the average times required for leaving work, travelling home, and preparing home for evacuation (120 minutes) after having received notice of evacuation (ComEd 1994).

4.20.3.7 Meteorology

Annual meteorology data sets from 1998 through 2001 were investigated for use in MACCS2. The 2000 data set was used, supplemented as follows to fill in the data gaps:

Available tower data were used whenever possible. For example, if the lower wind direction was unavailable, mid and/or upper directions were used to estimate the lower wind direction (or speed). If only a brief period of missing data existed, interpolation was used between hours.

Indirect measurements of other parameters were used to help fill data gaps (rapidly lowering temperatures may indicate a wind shift has occurred).

Hourly observations from Moline (Quad City Airport) were utilized to fill larger data voids.

Two meteorologists (one with over 20 years experience and the other with over 15 years experience) reviewed the data to interpret and suggest values to fill data gaps.

Wind speed and direction from the 10-meter sensor were combined with precipitation (hourly cumulative) and atmospheric stability (specified according to the vertical temperature gradient as measured between the 60-meter and 10-meter levels).

Atmospheric mixing heights were specified for am and pm hours. These values were taken as 500 and 1200 meters, respectively (NRC 1983).

4.20.3.8 MACCS2 Results

Table 4-4 shows the mean off-site doses and economic impacts to the region within 50 miles of QCNPS for each of eight release categories calculated using MACCS2. These impacts are multiplied by the annual frequency for each release category and then summed to obtain the risk-weighted mean doses and economic costs. Table 4-5 provides a summary of the QCNPS Level 2 PRA results.

4.20.4 COST BENEFIT ANALYSIS

This sub-section explains how EGC calculated the monetary value of the status quo (i.e., accident consequences without SAMA implementation). EGC also used this analysis to establish the maximum benefit that a SAMA could achieve if it eliminated all risk due to at-power internal events.

4.20.4.1 Off-Site Exposure Cost

The baseline annual off-site exposure risk was converted to dollars using the NRC's conversion factor of $2,000 per person-rem (NRC 1997a), and discounting to present value using NRC standard formula (NRC 1997a):

$$W_{pha} = C \times Z_{pha}$$

Where:

- W_{pha} = monetary value of public health risk after discounting
- C = $[1-\exp(-rt_f)]/r$
- t_f = years remaining until end of facility life = 20 years
- r = real discount rate (as fraction) = 0.07/year
- Z_{pha} = monetary value of public health (accident) risk per year before discounting ($/year)

The Level 3 analysis showed an annual off-site population dose risk of 1.67 person-rem. The calculated value for C using 20 years and a 7 percent discount rate is approximately 10.76. Therefore, calculating the discounted monetary equivalent of accident risk involves multiplying the dose (person-rem per year) by $2,000 and by the C value (10.76). The calculated off-site exposure cost is $35,948

4.20.4.2 Off-Site Economic Cost Risk (OECR)

The Level 3 analysis showed an annual off-site economic risk of $2,807. Calculated values for off-site economic costs caused by severe accidents must be discounted to present value as well. This is performed in the same manner as for public health risks and uses the same C value. The resulting value is $30,211.

4.20.4.3 On-Site Exposure Cost Risk

Occupational health was evaluated using the NRC methodology (NRC 1997a), which involves separately evaluating "immediate" and long-term doses.

Immediate Dose - For the case where the plant is in operation, the equation that NRC recommends using (NRC 1997a) is:

Equation 1:

$$W_{IO} = R\{(FD_{IO})_S - (FD_{IO})_A\}\{[1 - \exp(-rt_f)]/r\}$$

Where:

- W_{IO} = monetary value of accident risk avoided due to immediate doses, after discounting
- R = monetary equivalent of unit dose ($/person-rem)
- F = accident frequency (events/yr)
- D_{IO} = immediate occupational dose (person-rem/event)
- s = subscript denoting status quo (current conditions)

$_A$ = subscript denoting after implementation of proposed action
r = real discount rate
t_f = years remaining until end of facility life.

The values used in the QCNPS analysis are:

R = $2,000/person-rem
r = 0.07
D_{IO} = 3,300 person-rem/accident (best estimate)
t_f = 20 years (license extension period)
F = 2.19E-6 (total core damage frequency)

For the basis discount rate, assuming F_A is zero, the best estimate of the immediate dose cost is:

W_{IO} = R $(FD_{IO})_S$ {[1 - exp(-rt_f)]/r}
= 2,000*2.19E-6 *3,300*{[1-exp(-0.07*20)]/0.07}
= $156

Long-Term Dose - For the case where the plant is in operation, the NRC equation (NRC 1997a) is:

Equation 2:

W_{LTO} = R{$(FD_{LTO})_S$ -$(FD_{LTO})_A$} {[1 - exp(-rt_f)]/r}{[1-exp(-rm)]/rm}

Where:

W_{IO} = monetary value of accident risk avoided long-term doses, after discounting, $
m = years over which long-term doses accrue

The values used in the QCNPS analysis are:

R = $2,000/person-rem
r = 0.07
D_{LTO} = 20,000 person-rem/accident (best estimate)
m = "as long as 10 years"
t_f = 20 years (license extension period)
F = 2.19E-6 (total core damage frequency)

For the basis discount rate, assuming F_A is zero, the best estimate of the long-term dose is:

W_{LTO} = R $(FD_{LTO})_S$ {[1 - exp(-rt_f)]/r} {[1 - exp(-rm)]/rm}
= 2,000*2.19E-6 *20,000*{[1-exp(-0.07*20)]/0.07} {[1-exp(-0.07*10)]/0.07*10}
= $678

Total Occupational Exposure - Combining Equations 1 and 2 above and using the above numerical values, the total accident related on-site (occupational) exposure avoided (W_O) is:

W_O = W_{IO} + W_{LTO} = ($156 + $678) = $834

4.20.4.4 On-Site Cleanup and Decontamination Cost

The net present value that NRC provides for cleanup and decontamination for a single event is $1.1 billion, discounted over a 10-year cleanup period (NRC 1997a). NRC uses the following equation to integrate the net present value over the average number of remaining service years:

U_{CD} = [PV_{CD}/r][1-exp(-rt_f)]

Where:

PV_{CD} = net present value of a single event
r = real discount rate
t_f = years remaining until end of facility life.

The values used in the QCNPS analysis are:

PV_{CD} = $1.1E+9

$r = 0.07$
$t_f = 20$

The resulting net present value of cleanup integrated over the license renewal term, $1.18E+10, must be multiplied by the total core damage frequency of 2.19E-6 to determine the expected value of cleanup and decontamination costs. The resulting monetary equivalent is $25,928.

4.20.4.5 Replacement Power Cost

Long-term replacement power costs was determined following the NRC methodology (NRC 1997a). The net present value of replacement power for a single event, PVRP, was determined using the following equation:

$$PV_{RP} = [\$1.2E+8/r] * [1 - \exp(-rt_f)]^2$$

Where:

PV_{RP} = net present value of replacement power for a single event, ($)
r = 0.07
t_f = 20 years (license renewal period)

To attain a summation of the single-event costs over the entire license renewal period, the following equation is used:

$$U_{RP} = [PV_{RP}/r] * [1 - \exp(-rt_f)]^2$$

Where:

U_{RP} = net present value of replacement power over life of facility ($-year)

After applying a correction factor to account for QCNPS's size relative to the "generic" reactor described in NUREG/BR-0184 (NRC 1997a) (i.e., 912 MWe/910 MWe), the replacement power costs are determined to be 7.9E+9 ($-year). Multiplying this value by the CDF (2.19E-6) results in a replacement power cost of $17,318.

4.20.4.6 Total

The sum of the baseline costs is as follows:

Off-site exposure cost	=	$35,948
Off-site economic cost	=	$30,211
On-site exposure cost	=	$834
On-site cleanup cost	=	$25,928
Replacement Power cost	=	$17,318
Total cost	=	$110,239

EGC rounded this value up to $111,000 to use in screening out SAMAs as economically infeasible. The averted cost-risk calculations account for this rounding such that it does not impact the result. This cost estimate was used in screening out SAMAs that are not economically feasible; if the estimated cost of implementing a SAMA exceeded $111,000 it was discarded from further analysis. Exceeding this threshold would mean that a SAMA would not have a positive net value even if it could eliminate all severe accident costs. On the other hand, if the cost of implementation is less than this value, then a more detailed examination of the potential fractional risk benefit that can be attributed to the SAMA is performed.

4.20.5 PHASE I SAMA ANALYSIS: SAMA CANDIDATES AND SCREENING PROCESS

The initial list of Severe Accident Mitigation Alternative candidates for QCNPS was developed from lists of SAMAs at other nuclear power plants (SNC 2000, TVA 1994a, PECO 1989, TVA 1994b, TVA 1994c, and TVA 1992), NRC documents (NRC 1989b, NRC 1997c, NRC 1996, NRC 1995, NRC 1989a, NRC 1990 and NRC 1999), and documents related to advanced power reactor designs (GE 1994, WEC 1992, and NRC 1994). In addition, plant

specific analyses (NRC 1996, NRC 1994) have been used to identify potential SAMAs which address QCNPS vulnerabilities. This process is considered to adequately address the requirement of identifying significant safety improvements that could be performed at QCNPS.

The QCNPS IPEEE (ComEd 1997) also identified potential opportunities for plant improvements. As a result of the Seismic and Fire Analysis, potential plant changes were considered and dispositioned according to their importance.

Given the existing assessments of external events and internal fires at QCNPS, the cost benefit analysis uses the internal events PSA as the basis for measuring the impact of SAMA implementation. No fire or external events models are used in this analysis as the fire and IPEEE programs are considered to have already addressed potential plant improvements related to those categories.

This initial list was then screened to remove those candidates that were not applicable to QCNPS due to design differences or high implementation cost. In addition, SAMAs were eliminated if they were related to changes that would be made during the design phase of a plant rather than to an existing plant. These would typically screen on high cost, but they are categorized separately for reference purposes. The SAMA screening process is summarized in Figure 4-1.

A majority of the SAMAs were removed from further consideration as they did not apply to the GE BWR3/Mark I design used at QCNPS. The SAMA candidates that were found to be implemented at QCNPS were screened from further consideration.

The SAMAs related to design changes prior to construction (primarily consisting of those candidates taken from the ABWR SAMAs) were removed as they were not applicable to an existing site. Any candidate known to have an implementation cost that far exceeds any possible risk benefit is screened from further analysis. Any SAMA candidates that were sufficiently similar to other SAMA candidates were treated in the same manner as those other SAMA candidates.

A preliminary cost estimate was prepared for each of the remaining candidates to focus on those that had the possibility of having a positive benefit and to eliminate those whose costs were beyond the possibility of any corresponding benefit (as determined by the QCNPS baseline screening cost). When the screening cutoff of $111,000 was applied, a majority of the remaining SAMA candidates were eliminated, as their implementation costs were more expensive than the maximum postulated benefit associated with the elimination of all risk associated with full power internal events. This left 14 candidates for further analysis. Those SAMAs that required a more detailed cost benefit analysis are evaluated in Section 4.20.6.

4.20.6 PHASE II SAMA ANALYSIS

For each of the remaining SAMA candidates that could not be eliminated based on screening cost or PSA/application insights, a more detailed conceptual design was prepared. This information was then used to evaluate the effect of the candidates' changes upon the plant safety model. The impact that a specific SAMA has on the PSA model is conservatively evaluated to maximize the estimated cost benefit. In most instances, this averted cost value is compared qualitatively against an estimated cost to implement. A more detailed implementation cost assessment is made only if the benefit is close to the estimated implementation cost.

The final cost-risk based screening method used to determine the desirability of

implementing the SAMA is defined by the following equation:

Net Value = (baseline cost-risk of plant operation – cost-risk of plant operation with SAMA implemented) – cost of implementation

If the net value of the SAMA is negative, the cost of implementation is larger than the benefit associated with the SAMA and the SAMA is not considered beneficial. The baseline cost-risk of plant operation was derived using the methodology presented in Section 4.20.4. The cost-risk of plant operation with the SAMA implemented is determined in the same manner with the exception that the PSA results reflect the application of the SAMA to the plant (the baseline input is replaced by the results of a PSA sensitivity with the SAMA change in effect).

Subsections 4.20.6.1 – 4.20.6.14 describe the detailed cost benefit analysis that was used to determine how the remaining candidates were ultimately treated.

4.20.6.1 Phase II SAMA Number 1

Description: Provide means for alternate SSMP room cooling.

SSMP has alternate room cooling via a manual alignment to FPS. The SAMA would be yet a further enhancement.

Evaluate the benefit of providing alternate SSMP room cooling. These options may include:

- Controls in the main Control Room for remote alignment of SW or FPS to SSMP room cooling
- Procedures for opening SSMP room doors and using portable fans for SSMP room cooling

The approach to assessing this SAMA is to assume complete reliability of the room cooling function for SSMP. This would be the maximum benefit associated with a procedure change that provides alternate cooling to the SSMP compartment

The results from this case indicate a decrease from the base CDF of 2.19E-6/yr to 1.92E-6/yr (SAMA number 1). The decrease in CDF applies primarily to loss of DHR and late station blackout scenarios (Class II and IBL). The results of the cost benefit analysis are shown below:

Phase II SAMA Number 1 Net Value

Base Case: Cost-Risk for QCNPS	SAMA 1 Cost-Risk for QCNPS	Averted Cost-Risk	Cost of Implementation	Net Value
$111,000	$98,720	$12,280	Not Required	Not Cost Beneficial

Implementation of this SAMA would include potential procedural and hardware modifications to the plant. It is estimated that the cost of such changes would be substantially higher than the averted cost-risk. This SAMA would not be cost beneficial for QCNPS.

4.20.6.2 Phase II SAMA Number 2

Description: Develop an enhanced drywell spray system.

The Fire Protection system can already provide water to the RHR system at QCNPS; however, no procedures have been developed to use it as a containment spray source. This containment spray function could be further enhanced at QCNPS.

The modeling approach for this SAMA is to assign complete success to the drywell spray effectiveness in Level 2 for all sequences except Class II, IV, and V.

The results from this case indicate no reduction in CDF (base CDF = 2.19E-6/yr).

The results of the cost benefit analysis are shown below:

Phase II SAMA Number 2 Net Value

Base Case: Cost-Risk for QCNPS	SAMA 2 Cost-Risk for QCNPS	Averted Cost-Risk	Cost of Implementation	Net Value
$111,000	$100,297	$10,703	Not Required	Not Cost Beneficial

Implementation of this SAMA would involve procedural changes to the plant and is estimated to cost substantially more than the averted cost-risk. This SAMA is not judged to be cost beneficial for QCNPS.

4.20.6.3 Phase II SAMA Number 3

Description: Use fuel cells instead of lead-acid batteries.

SAMA would extend DC power availability in an SBO.

Improving battery capacity may be cost beneficial for QCNPS. Further extension of battery life with fuel cells is estimated to have a small impact on the QCNPS residual risk profile.

The modeling approach for this SAMA involves the assumption of indefinite (24 hours) of DC power capacity. This would allow RCIC operation until HCTL is reached in the 4 to 8 hour time frame. Therefore, the model is conservatively modeled to change the 4-hour offsite AC recovery to 8 hours to estimate the maximum benefit associated with the addition of fuel cells.

The results from this case indicate a decrease from the base CDF of 2.19E-6/yr to 2.06E-6/yr (SAMA number 3). The decrease in CDF applies to late station blackout scenarios (Class IBL). The results of the cost benefit analysis are shown below:

Phase II SAMA Number 3 Net Value

Base Case: Cost-Risk for QCNPS	SAMA 3 Cost-Risk for QCNPS	Averted Cost-Risk	Cost of Implementation	Net Value
$111 000	$106,338	$4 662	Not Required	Not Cost Beneficial

Implementation of this SAMA would involve hardware additions to the plant and is estimated to cost substantially more than the averted cost-risk. This SAMA would not be cost-beneficial for QCNPS.

4.20.6.4 Phase II SAMA Number 4

Description: Improve 4.16-kV bus cross-tie ability.

Procedures could be developed that would allow the following cross-ties to be performed:

- Bus 14-1 to Bus 24-1 from EDG 1
- Bus 24-1 to Bus 14-1 from EDG 2
- EDG 1/2 to Buses 13-1 and 23-1

The modeling approach to be used for this SAMA is to modify the operator action HEP that currently models this action by improving the HEP by a factor of 100 given new procedures.

The results from this case indicate a decrease from the base CDF of 2.19E-6/yr to 2.17E-6/yr (SAMA number 4). The decrease in CDF applies to late station blackout scenarios (Class IBL). The results of the cost benefit analysis are shown below:

Phase II SAMA Number 4 Net Value

Base Case: Cost-Risk for QCNPS	SAMA 4 Cost-Risk for QCNPS	Averted Cost-Risk	Cost of Implementation	Net Value
$111,000	$110,242	$758	Not Required	Not Cost Beneficial

This SAMA would involve procedural changes to the plant and is estimated to cost substantially more than the averted cost-risk value. Implementation of this SAMA, therefore, would not be cost beneficial for QCNPS.

4.20.6.5 Phase II SAMA Number 5

Description: Create a backup source for diesel cooling. (Not from existing system)

An additional EDG cooling source may be cost beneficial for QCNPS. This load path also includes ECCS room cooling.

This SAMA is modeled by assuming that all DGCW failures can be eliminated by the "new" cooling system for the Diesels. Conceptually, this is treated as the Diesel Fire Pump connected directly to the Diesels or a cooling backup that can be manually aligned. The model therefore sets the DGCW random failures to zero and the CCF of DGCW to zero.

The results from this case indicate a minor decrease from the base CDF of 2.19E-6/yr from SAMA number 5. The decrease in CDF applies to late station blackout scenarios (Class IBL). The results of the cost benefit analysis are shown below:

Phase II SAMA Number 5 Net Value

Base Case: Cost-Risk for QCNPS	SAMA 5 Cost-Risk for QCNPS	Averted Cost-Risk	Cost of Implementation	Net Value
$111,000	$111,000	0	Not Required	Not Cost Beneficial

This SAMA has essentially no significant impact on the calculated CDF. Implementation of this SAMA, therefore, would not be cost beneficial for QCNPS.

4.20.6.6 Phase II SAMA Number 6

Description: Provide procedures for (a) bypassing major DC buses; (b) locally starting equipment.

This SAMA would allow for powering specific loads given a DC bus failure and/or the ability to start equipment locally that normally requires DC power for a control room start.

The modeling approach used in this evaluation is to assume that the procedures change would completely eliminate all DC power failures as severe accidents.

The results from this case indicate a decrease from the base CDF of 2.19E-6/yr to 1.42E-6/yr (SAMA number 6). The decrease in CDF applies to total loss of DC scenarios (Class IE). The results of the cost benefit analysis are shown below:

Phase II SAMA Number 6 Net Value

Base Case: Cost-Risk for QCNPS	SAMA 6 Cost-Risk for QCNPS	Averted Cost-Risk	Cost of Implementation	Net Value
$111,000	79,013	$31,987	Not Required	Not Cost Beneficial

Bypassing major DC buses at QCNPS would require significant hardware changes. It is within craft capability to locally close breakers without DC power. However, writing procedure changes to do so would require considerable engineering work to determine in advance which systems and equipment could benefit from this process and what special alignments and considerations would be necessary for each of those pieces of equipment.

This SAMA would involve engineering work, and hardware and procedural changes to the plant, and, therefore, it is estimated to cost substantially more than the averted cost-risk value. Implementation of this

SAMA, therefore, would not be cost beneficial for QCNPS.

4.20.6.7 Phase II SAMA Number 7

Description: Delete High DW Pressure Signal from SDC isolation.

This SAMA would allow the initiation of SDC when the drywell is at elevated pressures.

The modeling of this SAMA is developed by setting the basic event, 1SDSYSPACIMPCT--, equal to zero. This provides the maximum benefit associated with the removal of the high drywell pressure interlock on the SDC.

The results from this case indicate a decrease from the base CDF of 2.19E-6/yr to 2.17E-6/yr (SAMA number 7). The decrease in CDF applies to loss of DHR scenarios (Class II). The results of the cost benefit analysis are shown below:

Phase II SAMA Number 7 Net Value

Base Case: Cost-Risk for QCNPS	SAMA 7 Cost-Risk for QCNPS	Averted Cost-Risk	Cost of Implementation	Net Value
$111,000	$110,188	$812	Not Required	Not Cost Beneficial

This SAMA would involve procedural changes to the plant which would cost substantially more than the averted cost-risk. Implementation of this SAMA, therefore, would not be cost beneficial for QCNPS.

4.20.6.8 Phase II SAMA Number 8

Description: Develop procedures to control Feedwater flow without 125 VDC power to prevent tripping Feedwater on High/Low level.

This SAMA increases the functionality of Feedwater in loss of DC scenarios and increases the probability of successful level control.

The modeling approach used in this evaluation is to assume that the procedure change would eliminate 50% of all DC power failures as severe accidents.

The results from this case indicate a decrease from the base CDF of 2.19E-6/yr to 1.79E-6/yr (SAMA number 9). The decrease in CDF applies to total loss of DC scenarios (Class IE). The results of the cost benefit analysis are shown below:

Phase II SAMA Number 8 Net Value

Base Case: Cost-Risk for QCNPS	SAMA 8 Cost-Risk for QCNPS	Averted Cost-Risk	Cost of Implementation	Net Value
$111,000	$94,306	$16,694	Not Required	Not Cost Beneficial

The difficulty of controlling feedwater without DC power at QCNPS is not with the feedwater control system but, rather, with the leakage past the closed feedwater regulation valves. Since it is not feasible to get such throttling valves to seal tightly, and since compensating actions are difficult with a loss of DC, writing such procedures would require significant developmental work, including engineering analysis. Whatever technique might be developed would require testing and experimentation. Finally, this SAMA would involve the cost of writing and processing procedures as well as training all operator crews on the required techniques. Because this SAMA would involve so much more that just procedure changes, it is estimated to cost substantially more than the averted cost-risk value. Implementation of this SAMA, therefore, would not be cost beneficial for QCNPS.

4.20.6.9 Phase II SAMA Number 9

Description: Remove Loop Select Logic.

In the event that there is no break in the recirc loops and there is a Loop "B" injection path failure, the Loop "A" injection path is precluded from use. Removal of the LPCI

Loop Select Logic or installation of a bypass switch would allow use of the "A" loop for injection in the event of a "B" injection path failure.

This SAMA is modeled by assuming that the LOOP select logic basic event selecting loop B is always 0.0 probability. This gives an equal probability of selecting A or B loops and is the most optimistic assessment of the SAMA implementation.

The results from this case indicate a minor decrease from the base CDF of 2.19E-6/yr for SAMA number 9. The decrease in CDF applies to LOCA without makeup scenarios (Class IIIC). The results of the cost benefit analysis are shown below:

Phase II SAMA Number 9 Net Value

Base Case: Cost-Risk for QCNPS	SAMA 9 Cost-Risk for QCNPS	Averted Cost-Risk	Cost of Implementation	Net Value
$111,000	$111,000	$0	Not Required	Not Cost Beneficial

This SAMA has essentially no impact on the calculated CDF. Implementation of this SAMA, therefore, would not be cost beneficial for QCNPS.

4.20.6.10 Phase II SAMA Number 10

Description: Demonstrate RCIC operability following depressurization.

Determine if demonstrating the operability of RCIC after depressurization is a cost-beneficial effort. Alternatively, Emergency Depressurization could be directed to be stopped at 100 psig.

The modeling approach used in this evaluation is to assume that RCIC remains operable regardless of suppression pool cooling. The model places RCIC in the QUV node for all non-LOCA, non-SORV, non-ATWS sequences.

The results from this case indicate a decrease from the base CDF of 2.19E-6/yr to 1.73E-6/yr (SAMA number 10). The decrease in CDF applies to loss of DHR scenarios (Class II). The results of the cost benefit analysis are shown below:

Phase II SAMA Number 10 Net Value

Base Case: Cost-Risk for QCNPS	SAMA 10 Cost-Risk for QCNPS	Averted Cost-Risk	Cost of Implementation	Net Value
$111,000	$89,536	$21,464	Not Required	Not Cost Beneficial

Revising procedures to stop reactor depressurization at 100 psig would be a major EOP change (QGA 500-1), the cost of which would easily exceed the averted cost risk. Demonstrating that RCIC will run reliably at very low reactor pressure and at an elevated suppression pool temperature would require analysis and equipment testing. Also, this SAMA would involve the cost of writing and processing procedures as well as training all operator crews on the required techniques.

Because this SAMA would involve so much more than just procedure changes, it is estimated to cost substantially more than the averted cost-risk value. Implementation of this SAMA, therefore, would not be cost beneficial for QCNPS.

4.20.6.11 Phase II SAMA Number 11

Description: Diversify the explosive valve operation.

An alternate means of opening a pathway to the RPV for SBLC injection would improve the success probability for reactor shutdown.

This SAMA is modeled by assuming that the random and common cause failure of the SLC explosive valves goes to zero by providing a perfectly redundant flow path.

The results from this case indicate a decrease from the base CDF of 2.19E-6/yr to 2.16E-6/yr (SAMA number 11). The decrease in CDF applies to ATWS scenarios (Class IV). The results of the cost benefit analysis are shown below:

Phase II SAMA Number 11 Net Value

Base Case: Cost-Risk for QCNPS	SAMA 11 Cost-Risk for QCNPS	Averted Cost-Risk	Cost of Implementation	Net Value
$111 000	$108,416	$2,584	Not Required	Not Cost Beneficial

This SAMA would involve hardware changes to the plant and would cost substantially more than the averted cost-risk value. Implementation of this SAMA, therefore, would not be cost beneficial for QCNPS.

4.20.6.12 Phase II SAMA Number 12

Description: Enrich Boron.

The increased boron concentration will reduce the time required to achieve the shutdown concentration. This will provide increased margin in the accident timeline for successful operator activation of SBLC.

The modeling approach used in this evaluation is to reduce the HEPs for boron initiation and RPV water level control by 50% to reflect the approximate improvement in operator success when the allowed time for action is increased due to the enriched boron.

The results from this case indicate a decrease from the base CDF of 2.19E-6/yr to 2.18E-6/yr (SAMA number 12). The decrease in CDF applies to ATWS scenarios (Class IV and IC). The results of the cost benefit analysis are shown below:

Phase II SAMA Number 12 Net Value

Base Case: Cost-Risk for QCNPS	SAMA 12 Cost-Risk for QCNPS	Averted Cost-Risk	Cost of Implementation	Net Value
$111 000	$110,282	$718	Not Required	Not Cost Beneficial

This SAMA has essentially no impact on the calculated CDF would cost substantially more than the averted cost-risk value. Implementation of this SAMA, therefore, would not be cost beneficial for QCNPS.

4.20.6.13 Phase II SAMA Number 13

Description: Passive Overpressure Relief.

This SAMA will prevent catastrophic failure of the containment. Controlled relief through a selected vent path has a greater potential for reducing the release of radioactive material than through a random break.

QCNPS has installed a hard piped containment vent system that provides a controlled means of containment overpressure relief. The passive feature of adding a rupture disk to this system introduces competing risks that limit the usefulness of the vent over the spectrum of severe accidents.

This SAMA is modeled by assuming that vent failure modes go to zero.

The results from this case indicate a decrease from the base CDF of 2.19E-6/yr to 2.04E-6/yr (SAMA number 13). The decrease in CDF applies to loss of DHR scenarios (Class II). The results of the cost benefit analysis are shown below:

Phase II SAMA Number 13 Net Value

Base Case: Cost-Risk for QCNPS	SAMA 13 Cost-Risk for QCNPS	Averted Cost-Risk	Cost of Implementation	Net Value
$111,000	$103,783	$7,217	Not Required	Not Cost Beneficial

This SAMA would involve hardware changes to the plant and would cost substantially more than the averted cost-risk value. Implementation of this SAMA, would not be cost beneficial for QCNPS.

4.20.6.14 Phase II SAMA Number 14

Description: Control containment venting within a narrow band of pressure.

This SAMA was derived from the QCNPS Risk Insights document to establish a narrow pressure control band that would thereby prevent rapid containment depressurization when venting is implemented thus avoiding adverse impacts on the low pressure ECCS injection systems taking suction from the torus.

The modeling approach used in this evaluation is that CS and LPCI continue to successfully inject if they have been determined to be available in the accident sequence. Specifically, SSMP or CRD are not required to be operational when venting is initiated, but they would be required for the case where containment failure has led to a "vented" containment. However, for simplicity in modeling, the conservative assessment is made to assume that all Class IIV sequences can be eliminated.

The results from this case indicate a decrease from the base CDF of 2.19E-6/yr to 1.69E-6/yr (SAMA number 14). The decrease in CDF applies to loss of DHR scenarios (Class II). The results of the cost benefit analysis are shown below:

Phase II SAMA Number 14 Net Value

Base Case: Cost-Risk for QCNPS	SAMA 14 Cost-Risk for QCNPS	Averted Cost-Risk	Cost of Implementation	Net Value
$111,000	$87,450	$23,550	Not Required	Not Cost Beneficial

The current procedures, QGA 200 and QCOP 1600-13, allow the operator considerable freedom with containment venting. The operator has to vent to stay below the Primary Containment Pressure Limit (PCPL), but beyond that requirement, the strategy is flexible. The prudent operator will wish to minimize releases, so his tendency will be to vent to get some margin below PCPL, but not go much below 45 or 50 psig in containment. Furthermore, this action is not needed until late in the event. There is plenty of time for the Emergency Response Organization to develop a strategy to supplement the limited guidance in the existing procedure.

Considering that nearly all SAMA benefits are available without procedure changes, and considering the costs of procedure changes and training, implementation of this SAMA would not be cost beneficial for QCNPS.

4.20.7 PHASE II SAMA ANALYSIS SUMMARY

The SAMA candidates which could not be eliminated from consideration by the baseline screening process or other PSA insights required the performance of a detailed analysis of the averted cost-risk and SAMA implementation costs. SAMA candidates are potentially justified only if the averted cost-risk resulting from the modification is greater than the cost of implementing the SAMA. None of the SAMAs analyzed were found to be cost-beneficial as defined by the methodology used in this study. However, this evaluation should not necessarily be considered a definitive guide in determining the

disposition of a plant modification that has been analyzed using other engineering methods. These results are intended to provide information about the relative estimated risk benefit associated with a plant change or modification compared with its cost of implementation and should be used as an aid in the decision making process. The results of the detailed analysis are shown in Table 4-6.

4.20.8 CONCLUSIONS

The benefits of revising the operational strategies in place at QCNPS and/or implementing hardware modifications can be evaluated without the insight from a risk-based analysis. Use of the PSA in conjunction with cost benefit analysis methodologies has, however, provided an enhanced understanding of the effects of the proposed changes relative to the cost of implementation and projected impact on a much larger future population. The results of this study indicate that of the identified potential improvements that can be made at QCNPS, none are cost beneficial based on the methodology applied in this analysis.

Table 4-1. Category 1 Issues that are not Applicable to Quad Cities Nuclear Power Station (QCNPS).[a]

	Issues	Basis for Inapplicability to QCNPS
	Surface Water Quality, Hydrology, and Use (for all plants)	
1.	Impacts of refurbishment on surface water quality	Issue applies to refurbishment, which QCNPS will not undertake
2.	Impacts of refurbishment on surface water use	Issue applies to refurbishment, which QCNPS will not undertake.
4	Altered salinity gradients	Issue applies to discharge to a natural water body that has a salinity gradient to alter, not inland freshwaters.
5.	Altered thermal stratification of lakes	Issue applies to plants using lakes for cooling. QCNPS uses a river.
	Aquatic Ecology (for all plants)	
14.	Refurbishment	Issue applies to refurbishment, which QCNPS will not undertake
	Aquatic Ecology (for plants with cooling-tower-based heat dissipation systems)	
28.	Entrainment of fish and shellfish in early life stages	Issue applies to plants with cooling tower-based heat dissipation systems; QCNPS has a once-through cooling system.
29.	Impingement of fish and shellfish	Issue applies to plants with cooling tower-based heat dissipation systems, QCNPS has a once-through cooling system.
30	Heat shock	Issue applies to plants with cooling tower-based heat dissipation systems; QCNPS has a once-through cooling system
	Groundwater Use and Quality	
31.	Impacts of refurbishment on groundwater use and quality	Issue applies to refurbishment, which QCNPS will not undertake.
32	Groundwater use conflicts (potable and service water; plants that use < 100 gpm)	QCNPS withdraws more than 100 gpm.
36.	Groundwater quality degradation (Ranney wells)	Issue applies to a plant feature, Ranney wells, that QCNPS does not have.
37.	Groundwater quality degradation (saltwater intrusion)	Issue applies to plants in coastal areas, not inland sites such as QCNPS.
38	Groundwater quality degradation (cooling ponds in salt marshes)	Issue applies to cooling ponds[b] in salt marshes, not inland sites such as QCNPS.
	Terrestrial Resources	
41.	Cooling tower impacts on crops and ornamental vegetation	Issue applies to plants with cooling tower-based heat dissipation systems; QCNPS has a once-through cooling system.
42.	Cooling tower impacts on native plants	Issue applies to plants with cooling tower-based heat dissipation systems; QCNPS has a once-through cooling system.
43	Bird collisions with cooling towers	Issue applies to plants with cooling tower-based heat dissipation systems; QCNPS has a once-through cooling system.
44	Cooling pond impacts on terrestrial resources	Issue applies to plants with cooling pond-based heat dissipation systems; QCNPS has a once-through cooling system.

Table 4-1. Category 1 Issues that are not Applicable to Quad Cities Nuclear Power Station (QCNPS)[a] (Continued).

Issues		Basis for Inapplicability to QCNPS
		Human Health
54.	Radiation exposures to the public during refurbishment	Issue applies to refurbishment, which QCNPS will not undertake.
55	Occupational radiation exposures during refurbishment	Issue applies to refurbishment, which QCNPS will not undertake.
56	Microbiological organisms (occupational health)	Issue applies to plants with cooling tower-based heat dissipation systems; QCNPS has a once-through cooling system.
		Socioeconomics
72.	Aesthetic impacts (refurbishment)	Issue applies to refurbishment, which QCNPS will not undertake

< =less than

gpm =gallons per minute

NRC =U.S. Nuclear Regulatory Commission

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

b. NRC has defined "cooling pond" as "a manmade impoundment that does not impede the flow of a navigable system and that is used primarily to remove waste heat from condenser water prior to recirculating the water back to the main condenser...." (NRC 1996).

Table 4-2. Category 1 and "NA" Issues that are Applicable to Quad Cities Nuclear Power Station (QCNPS).[a]

	Issue	NRC Findings[b]	GEIS Section/Page
	Surface Water Quality, Hydrology, and Use (for all plants)		
3.	Altered current patterns at intake and discharge structures	SMALL. Altered current patterns have not been found to be a problem at operating nuclear power plants and are not expected to be a problem during the license renewal term.	4 2 1 2.1/4-4 4.3 2 2/4-31 4.4 2/4-52
6.	Temperature effects on sediment transport capacity	SMALL. These effects have not been found to be a problem at operating nuclear power plants and are not expected to be a problem during the license renewal term.	4 2.1 2.3/4-6 4 4 2.2/4-53
7.	Scouring caused by discharged cooling water	SMALL. Scouring has not been found to be a problem at most operating nuclear power plants and has caused only localized effects at a few plants. It is not expected to be a problem during the license renewal term	4 2.1 2.3/4-6 4 4.2 2/4-53
8.	Eutrophication	SMALL. Eutrophication has not been found to be a problem at operating nuclear power plants and is not expected to be a problem during the license renewal term.	4 2.1.2.3/4-6 4.4.2 2/4-53
9.	Discharge of chlorine or other biocides	SMALL. Effects are not a concern among regulatory and resource agencies, and are not expected to be a problem during the license renewal term.	4.2.1.2 4/4-10 4 4 2 2/4-53
10.	Discharge of sanitary wastes and minor chemical spills	SMALL. Effects are readily controlled through NPDES permit and periodic modifications, if needed, and are not expected to be a problem during the license renewal term.	4 2.1.2.4/4-10 4 4 2 2/4-53
11.	Discharge of other metals in waste water	SMALL. These discharges have not been found to be a problem at operating nuclear power plants with cooling-tower-based heat dissipation systems and have been satisfactorily mitigated at other plants. They are not expected to be a problem during the license renewal term.	4 2.1 2 4/4-10 4.3.2 2/4-31 4 4 2 2/4-53
12	Water use conflicts (plants with once-through cooling systems)	SMALL. These conflicts have not been found to be a problem at operating nuclear power plants with once-through heat dissipation systems.	4 2 1 3/4-13
	Aquatic Ecology (for all plants)		
15.	Accumulation of contaminants in sediments or biota	SMALL. Accumulation of contaminants has been a concern at a few nuclear power plants, but has been satisfactorily mitigated by replacing copper alloy condenser tubes with those of another metal. It is not expected to be a problem during the license renewal term	4 2.1.2.4/4-10 4 3 3/4-33 4.4 2 2/4-53 4.4.3/4-56
16.	Entrainment of phytoplankton and zooplankton	SMALL. Entrainment of phytoplankton and zooplankton has not been found to be a problem at operating nuclear power plants and is not expected to be a problem during the license renewal term.	4 2 2 1 1/4-15 4.3.3/4-33 4 4 3/4-56
17.	Cold shock	SMALL. Cold shock has been satisfactorily mitigated at operating nuclear plants with once-through cooling systems, has not endangered fish populations or been found to be a problem at operating nuclear power plants with cooling towers or cooling ponds, and is not expected to be a problem during the license renewal term	4.2 2 1.5/4-18 4.3 3/4-33 4.4.3/4-56

Table 4-2. Category 1 and "NA" Issues that are Applicable to Quad Cities Nuclear Power Station (QCNPS)[a] (Continued).

	Issue	NRC Findings[b]	GEIS Section/Page
18.	Thermal plume barrier to migrating fish	SMALL. Thermal plumes have not been found to be a problem at operating nuclear power plants and are not expected to be a problem during the license renewal term.	4 2.2.1.6/4-19 4.4 3/4-56
19.	Distribution of aquatic organisms	SMALL. Thermal discharge may have localized effects, but is not expected to affect the larger geographical distribution of aquatic organisms.	4 2.2.1.6/4-19 4.4.3/4-56
20.	Premature emergence of aquatic insects	SMALL. Premature emergence has been found to be a localized effect at some operating nuclear power plants, but has not been a problem and is not expected to be a problem during the license renewal term.	4 2.2 1 7/4-20 4.4.3/4-56
21.	Gas supersaturation (gas bubble disease)	SMALL. Gas supersaturation was a concern at a small number of operating nuclear power plants with once-through cooling systems, but has been satisfactorily mitigated. It has not been found to be a problem at operating nuclear power plants with cooling towers or cooling ponds and is not expected to be a problem during the license renewal term.	4 2 2.1.8/4-21 4.4.3/4-56
22	Low dissolved oxygen in the discharge	SMALL. Low dissolved oxygen has been a concern at one nuclear power plant with a once-through cooling system, but has been effectively mitigated. It has not been found to be a problem at operating nuclear power plants with cooling towers or cooling ponds and is not expected to be a problem during the license renewal term	4.2.2.1.9/4-23 4 3 3/4-33 4.4.3/4-56
23.	Losses from predation, parasitism, and disease among organisms exposed to sublethal stresses	SMALL. These types of losses have not been found to be a problem at operating nuclear power plants and are not expected to be a problem during the license renewal term	4 2.2 1.10/4-24 4 4 3/4-56
24.	Stimulation of nuisance organisms (e g., shipworms)	SMALL. Stimulation of nuisance organisms has been satisfactorily mitigated at the single nuclear power plant with a once-through cooling system where previously it was a problem. It has not been found to be a problem at operating nuclear power plants with cooling towers or cooling ponds and is not expected to be a problem during the license renewal term.	4.2.2 1 11/4-25 4 4 3/4-56
		Terrestrial Resources	
45.	Power line right-of-way management (cutting and herbicide application)	SMALL. The impacts of right-of-way maintenance on wildlife are expected to be of small significance at all sites.	4 5.6 1/4-71
46.	Bird collision with power lines	SMALL. Impacts are expected to be of small significance at all sites.	4.5 6 2/4-74
47.	Impacts of electromagnetic fields on flora and fauna (plants, agricultural crops, honeybees, wildlife, livestock)	SMALL. No significant impacts of electromagnetic fields on terrestrial flora and fauna have been identified Such effects are not expected to be a problem during the license renewal term	4 5 6 3/4-77
48	Floodplains and wetlands on power line right of way	SMALL. Periodic vegetation control is necessary in forested wetlands underneath power lines and can be achieved with minimal damage to the wetland No significant impact is expected at any nuclear power plant during the license renewal term.	4 5 7/4-81

Table 4-2. Category 1 and "NA" Issues that are Applicable to Quad Cities Nuclear Power Station (QCNPS)[a] (Continued).

	Issue	NRC Findings[b]	GEIS Section/Page
		Air Quality	
51.	Air quality effects of transmission lines	SMALL. Production of ozone and oxides of nitrogen is insignificant and does not contribute measurably to ambient levels of these gases.	4.5 2/4-62
		Land Use	
52.	Onsite land use	SMALL. Projected onsite land use changes required during refurbishment and the renewal period would be a small fraction of any nuclear power plant site and would involve land that is controlled by the applicant.	3 2/3-1
53	Power line right-of-way	SMALL. Ongoing use of power line right of ways would continue with no change in restrictions. The effects of these restrictions are of small significance.	4 5 3/4-62
		Human Health	
58.	Noise	SMALL. Noise has not been found to be a problem at operating plants and is not expected to be a problem at any plant during the license renewal term	4.3.7/4-49
60.	Electromagnetic fields, chronic effects	Not Applicable. Biological and physical studies of 60-Hz electromagnetic fields have not found consistent evidence linking harmful effects with field exposures However, research is continuing in this area and a consensus scientific view has not been reached.	4 5 4 2/4-67
61.	Radiation exposures to public (license renewal term)	SMALL. Radiation doses to the public will continue at current levels associated with normal operations.	4 6 2/4-87
62.	Occupational radiation exposures (license renewal term)	SMALL. Projected maximum occupational doses during the license renewal term are within the range of doses experienced during normal operations and normal maintenance outages, and would be well below regulatory limits	4 6.3/4-95
		Socioeconomics	
64.	Public services: public safety, social services, and tourism and recreation	SMALL. Impacts to public safety, social services, and tourism and recreation are expected to be of small significance at all sites.	4.7.3 3/4-106 (safety) 4.7.3/4-104 (public services) 4.7 3.4/4-107 (social) 4.7 3 6/4-107 (tourism, recreation)
67.	Public services, education (license renewal term)	SMALL. Only impacts of small significance are expected.	4 7 3.1/4-106
73.	Aesthetic impacts (license renewal term)	SMALL. No significant impacts are expected during the license renewal term.	4.7 6/4-111
74.	Aesthetic impacts of transmission lines (license renewal term)	SMALL. No significant impacts are expected during the license renewal term.	4.5 8/4-83
		Postulated Accidents	
75.	Design basis accidents	SMALL. The NRC staff has concluded that the environmental impacts of design basis accidents are of small significance for all plants.	5 3 2/5-11 5 5 1/5-114 (summary)

Table 4-2. Category 1 and "NA" Issues that are Applicable to Quad Cities Nuclear Power Station (QCNPS)[a] (Continued).

	Issue	NRC Findings[b]	GEIS Section/Page
		Uranium Fuel Cycle and Waste Management	
77.	Offsite radiological impacts (individual effects from other than the disposal of spent fuel and high level waste)	SMALL. Off-site impacts of the uranium fuel cycle have been considered by the Commission in Table S-3 of this part. Based on information in the GEIS, impacts on individuals from radioactive gaseous and liquid releases including radon-222 and technetium-99 are small.	6 2 4/6-27 6 6/6-87
78.	Offsite radiological impacts (collective effects)	The 100-year environmental dose commitment to the U S. population from the fuel cycle, high-level waste and spent fuel disposal is calculated to be about 14,800 person rem, or 12 cancer fatalities, for each additional 20-year power reactor operating term. Much of this, especially the contribution of radon releases from mines and tailing piles, consists of tiny doses summed over large populations. This same dose calculation can theoretically be extended to include many tiny doses over additional thousands of years as well as doses outside the U.S The result of such a calculation would be thousands of cancer fatalities from the fuel cycle, but this result assumes that even tiny doses have some statistical adverse health effect, which will not ever be mitigated (for example, no cancer cure in the next thousand years), and that these dose projections over thousands of years are meaningful. However, these assumptions are questionable. In particular, science cannot rule out the possibility that there will be no cancer fatalities from these tiny doses. For perspective, the doses are very small fractions of regulatory limits, and even smaller fractions of natural background exposure to the same populations. Nevertheless, despite all the uncertainty, some judgment as to the regulatory 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 collective effects of the fuel cycle, this issue is considered Category 1.	Not in GEIS

Table 4-2. Category 1 and "NA" Issues that are Applicable to Quad Cities Nuclear Power Station (QCNPS)[a] (Continued).

	Issue	NRC Findings[b]	GEIS Section/Page
79	Offsite radiological impacts (spent fuel and high-level waste disposal)	For the high-level waste and spent fuel disposal component of the fuel cycle, there are no current regulatory limits for offsite releases of radionuclides for the current candidate repository site. However, if we assume that limits are developed along the lines of the 1995 National Academy of Sciences (NAS) report, "Technical Bases for Yucca Mountain Standards," and that in accordance with the Commission's Waste Confidence Decision, 10 CFR 51 23, a repository can and likely will be developed at some site which will comply with such limits, peak doses to virtually all individuals will be 100 millirem per year or less However, while the Commission has reasonable confidence that these assumptions will prove correct, there is considerable uncertainty since the limits are yet to be developed, no repository application has been completed or reviewed, and uncertainty is inherent in the models used to evaluate possible pathways to the human environment The NAS report indicated that 100 millirem per year should be considered as a starting point for limits for individual doses, but notes that some measure of consensus exists among national and international bodies that the limits should be a fraction of the 100 millirem per year. The lifetime individual risk from 100 millirem annual dose limit is about 310^{-3}. Estimating cumulative doses to populations over thousands of years is more problematic. The likelihood and consequences of events that could seriously compromise the integrity of a deep geologic repository were evaluated by the U.S. Department of Energy in the "Final Environmental Impact Statement: Management of Commercially Generated Radioactive Waste," October 1980. The evaluation estimated the 70-year whole-body dose commitment to the maximum individual and to the regional population resulting from several modes of breaching a reference repository in the year of closure, after 1,000 years, after 100,000 years, and after 100,000,000 years. Subsequently, the NRC and other federal agencies have expended considerable effort to develop models for the design and for the licensing of a high-level waste repository, especially for the candidate repository at Yucca Mountain. More meaningful estimates of doses to 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	Not in GEIS.

Table 4-2. Category 1 and "NA" Issues that are Applicable to Quad Cities Nuclear Power Station (QCNPS)[a] (Continued).

	Issue	NRC Findings[b]	GEIS Section/Page
		protect the population by imposing "containment requirements" that limit the cumulative amount of radioactive material released over 10,000 years. The cumulative release limits are based on EPA's population impact goal of 1,000 premature cancer deaths worldwide for a 100,000 metric ton (MTHM) repository. Nevertheless, despite all the uncertainty, some judgment as to the regulatory NEPA implications of these matters should be made and it makes no sense to repeat the same judgment in every case. Even taking the uncertainties into account, the Commission concludes that these impacts are acceptable in that these impacts would not be sufficiently large to require the NEPA conclusion, for any plant, that the option of extended operation under 10 CFR part 54 should be eliminated. Accordingly, while the Commission has not assigned a single level of significance for the impacts of spent fuel and high-level waste disposal, this issue is considered Category 1.	
80	Nonradiological impacts of the uranium fuel cycle	SMALL. The nonradiological impacts of the uranium fuel cycle resulting from the renewal of an operating license for any plant are found to be small	6 2 2.6/6-20 (land use) 6 2 2 7/6-20 (water use) 6 2 2 8/6-21 (fossil fuel) 6 2 2 9/6-21 (chemical) 6 6/6-90 (conclusion)
81.	Low-level waste storage and disposal	SMALL The comprehensive regulatory controls that are in place, and the low public doses being achieved at reactors, ensure that the radiological impacts to the environment will remain small during the term of a renewed license The maximum additional onsite land that may be required for low-level waste storage during the term of a renewed license and associated impacts will be small. Nonradiological impacts on air and water will be negligible. The radiological and nonradiological environmental impacts of long-term disposal of low-level waste from any individual plant at licensed sites are small. In addition, the Commission concludes that there is reasonable assurance that sufficient low-level waste disposal capacity will be made available when needed for facilities to be decommissioned consistent with NRC decommissioning requirements	6 4 2/6-36 ("low-level" definition) 6 4 3/6-37 (low-level volume) 6 4 4/6-48 (renewal effects) 6 6/6-90 (conclusion)
82.	Mixed waste storage and disposal	SMALL The comprehensive regulatory controls and the facilities and procedures that are in place ensure proper handling and storage, as well as negligible doses and exposure to toxic materials for the public and the environment at all plants License renewal will not increase the small, continuing risk to human health and the environment posed by mixed waste at all plants The radiological nonradiological environmental impacts of long-term disposal of mixed waste from any individual plant at licensed sites are small In addition, the Commission concludes that there is reasonable assurance that sufficient mixed waste disposal capacity will be made available when needed for facilities to be decommissioned consistent with NRC decommissioning requirements.	6 4.5/6-63 6 6/6-91 (conclusion)

Table 4-2. Category 1 and "NA" Issues that are Applicable to Quad Cities Nuclear Power Station (QCNPS)[a] (Continued).

	Issue	NRC Findings[b]	GEIS Section/Page
83.	On-site spent fuel	SMALL 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.	6 4 6/6-70 6 6/6-91 (conclusion)
84.	Nonradiological waste	SMALL. No changes to generating systems are anticipated for license renewal. Facilities and procedures are in place to ensure continued proper handling and disposal at all plants	6.5/6-86 6 6/6-92 (conclusion)
85	Transportation[c]	SMALL. The impacts of transporting spent fuel enriched up to 5 percent uranium-235 with average burnup for the peak rod to current levels approved by NRC up to 62,000 MWd/MTU and the cumulative impacts of transporting high-level waste to a single repository, such as Yucca Mountain, Nevada are found to be consistent with the impact values contained in 10 CFR 51.52(c), Summary Table S-4-Environmental Impact of Transportation of Fuel and Waste to and from One Light-Water-Cooled Nuclear 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 §51 52.	Addendum 1
		Decommissioning	
86.	Radiation doses	SMALL. Doses to the public will be well below applicable regulatory standards regardless of which decommissioning method is used. Occupational doses would increase no more than 1 man-rem caused by buildup of long-lived radionuclides during the license renewal term.	7.3.1/7-15 7.4/7-25 (conclusion)
87.	Waste management	SMALL. Decommissioning at the end of a 20-year license renewal period would generate no more solid wastes than at the end of the current license term. No increase in the quantities of Class C or greater than Class C wastes would be expected.	7.3.2/7-19 7 4/7-25 (conclusion)
88	Air quality	SMALL. Air quality impacts of decommissioning are expected to be negligible either at the end of the current operating term or at the end of the license renewal term.	7 3 3/7-21 7.4/7-25 (conclusion)
89.	Water quality	SMALL. The potential for significant water quality impacts from erosion or spills is no greater whether decommissioning occurs after a 20-year license renewal period or after the original 40-year operation period, and measures are readily available to avoid such impacts.	7 3 4/7-21 7.4/7-25 (conclusion)
90.	Ecological resources	SMALL. Decommissioning after either the initial operating period or after a 20-year license renewal period is not expected to have any direct ecological impacts.	7.3 5/7-21 7.4/7-25 (conclusion)
91.	Socioeconomic impacts	SMALL. 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.	7.3.7/7-24 7 4/7-25 (conclusion)

Table 4-2. Category 1 and "NA" Issues that are Applicable to Quad Cities Nuclear Power Station (QCNPS)[a] (Continued).

	Issue	NRC Findings[b]	GEIS Section/Page
		Environmental Justice	
92.	Environmental Justice	Not Applicable. The need for and the content of an analysis of environmental justice will be addressed in plant-specific reviews.	Not in GEIS

CFR = Code of Federal Regulations
EPA = U.S. Environmental Protection Agency
GEIS = Generic Environmental Impact Statement (NRC 1996)
Hz = Hertz
NA = Not applicable
NEPA = National Environmental Policy Act
NPDES = National Pollutant Discharge Elimination System
NRC = U.S. Nuclear Regulatory Commission

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

b. NRC has defined SMALL to mean that, for the issue, environmental effects are not detectable or are so minor that they would neither destabilize nor noticeably alter any important attribute of the resource. For the purposes of assessing radiological impacts, NRC has concluded that those impacts that do not exceed permissible levels in the NRC's regulations are considered small (10 CFR 51 Appendix B, Table B-1, Footnote 3)

c NRC published, on September 3, 1999, a GEIS addendum in support of its rulemaking that re-categorized Issue 85 from 2 to 1.

Table 4-3. Results of Induced Current Analysis.

Transmission Line	Voltage (kV)	Limiting Case Peak Electric Field Strength (kV/meter)	Limiting Case Induced Current (milliamperes)
Davenport[a] (0401)	345	5.7	5.4
Barstow[a] (0402)	345	2.0	2.2
Nelson – South[b] (0403)	345	2.0	2.2
Nelson – North[b] (0404)	345	6.3	6.0
Rock Creek[c] (0405)	345	3.8	4.1

a. Owned and operated by MidAmerican Energy.
b Owned and operated by ComEd
c. Owned and operated by Alliant Energy.

Table 4-4. MACCS Results.

MAAP Run	Release Category	Dose (Sv)	Costs($)	Frequency	Wtd. Dose (p-rem)	Wtd. Cost ($)
QC0053	L2-1	2.16E+04	4.08E+09	2.50E-07	5.40E-01	1.02E+03
QC0082	L2-2	1.62E+04	3.70E+09	4.10E-08	6.64E-02	1.52E+02
QC0085	L2-4	1.53E+04	2.81E+09	2.50E-07	3.83E-01	7.03E+02
QC0061	L2-5	6.14E+03	9.07E+08	8.00E-07	4.91E-01	7.26E+02
QC0057	L2-7	8.54E+03	1.25E+09	9.70E-09	8.28E-03	1.21E+01
QC0058	L2-8	3.35E+03	3.15E+08	3.20E-07	1.07E-01	1.01E+02
QC0070	L2-9	4.11E+04	5.23E+09	1.80E-08	7.40E-02	9.41E+01
QC0074	L2-10	4.36E+00	1.26E+04	5.00E-07	2.18E-04	6.30E-03
Frequency Weighted Totals (p-rem and $)				2.189E-06	1.67E+00	2806.8713

Table 4-5. Accident Sequence Timings as a Function of Consequence Category - Base Case.

Consequence Category	Dominant Release Category	MAAP Case	Time of Initial Release	Time of Gen. Emg. Declaration	Time of End of Release	EAL Basis	Release Frequency (Per Rx Yr)
L2-1	H/E (LERF)	QC 0053 IA-L2-1A-NSPR	4 4 hr	60 min	36 hr	FG1	2 5E-7[a]
L2-2	H/I	QC 0082 IIA-L2-9C[d]	51.4 hr	15 hr	72 hr	HG2	4.1E-8[b]
L2-3	H/L	None	--	--	--	--	--
L2-4	M/E	QC-0085 IVA-L2-14B-ED-WW	55 min	55 min	36 hr	FG1	2 5E-7
L2-5	M/I	QC 0061 IIA-I2-9a	39 3 hr	15 hr	72 hr	HG2	8 0E-7[c]
L2-6	M/L	None	--	--	--	--	--
L2-7	L/E or LL/E	QC-057 ID-L2-7B NSPR	5.7 hr	45 min	36 hr	FG1	9.7E-9
L2-8	L/I or LL/I or L/L or LL/L	QC 0058 ID-L2-7BA-SPRY	25.9 hr	15 hr	36 hr	HG2	3.2E-7
L2-9	Class V	QC OO70 V-L2-17	17 min	20 min	36 hr	FG1	1.8E-8
L2-10	Intact	QC 0074 IB-L2-22	48 min	60 min	36 hr	FG1	5 0E-7

a. Does not include Class V (see L2-9)
b. Includes H/I and H/L
c. Includes M/I and M/L
d Containment fails at 45.9 hr.

Table 4-6. Summary of the Detailed SAMA Analyses.

Phase II SAMA ID	Averted Cost- Risk	Cost of Implementation	Net Value	Cost Beneficial?
1	$12,280	Not Required	N/A	No
2	$10,703	Not Required	N/A	No
3	$4,662	Not Required	N/A	No
4	$758	Not Required	N/A	No
5	$0	Not Required	0	No
6	$31,987	Not Required	N/A	No
7	$812	Not Required	N/A	No
8	$16,694	Not Required	N/A	No
9	$0	Not Required	0	No
10	$21,464	Not Required	N/A	No
11	$2,584	Not Required	N/A	No
12	$718	Not Required	N/A	No
13	$7,217	Not Required	N/A	No
14	$23,550	Not Required	N/A	No

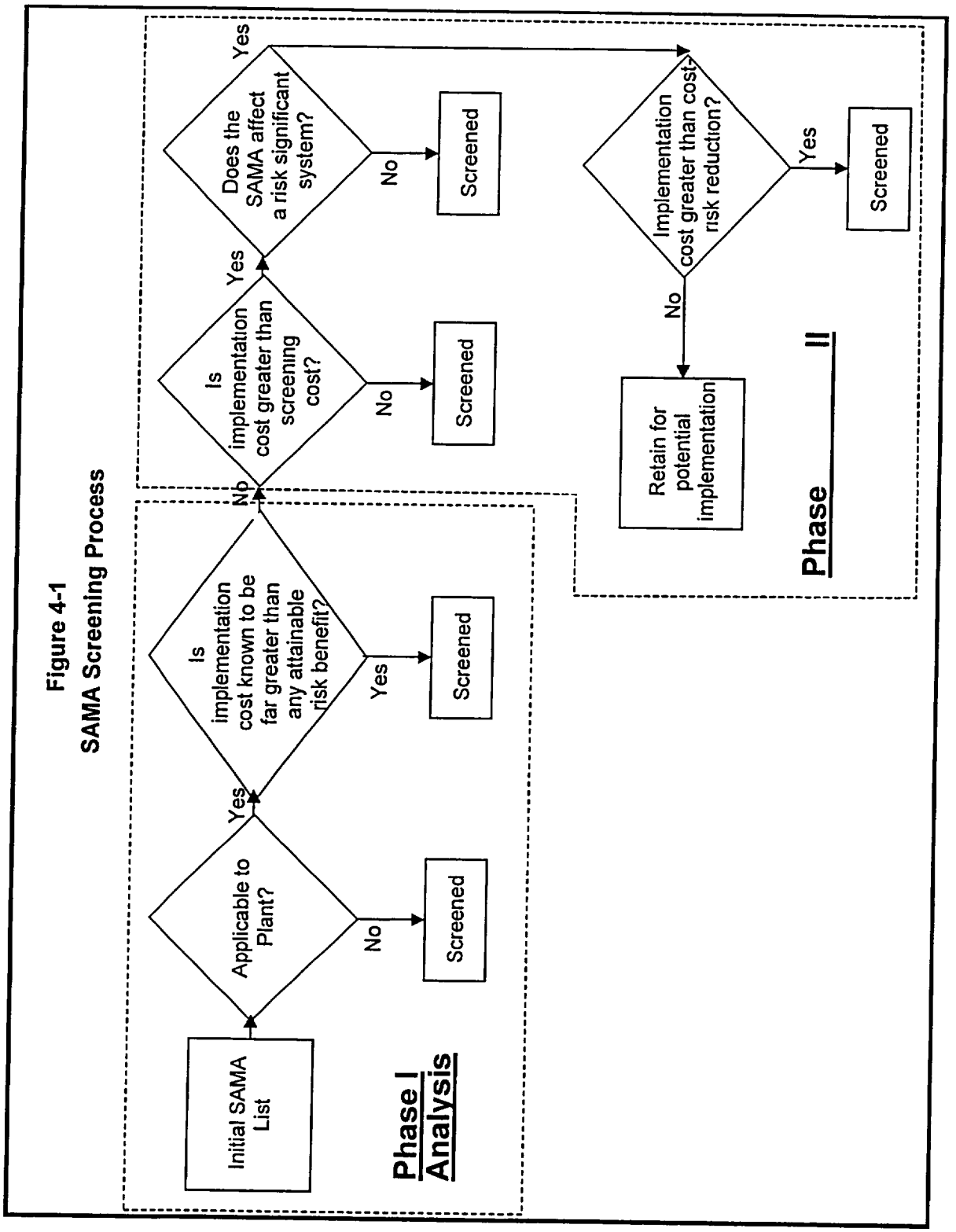


Figure 4-1
SAMA Screening Process

4.21 References

Note to reader: Some web pages cited in this document are no longer available, or are no longer available through the original URL addresses. Hard copies of all cited web pages are available in EGC files. Some sites, for example the census data, cannot be accessed through their URLs. The only way to access these pages is to follow queries on previous web pages. The complete URLs used by EGC have been given for these pages, even though they may not be directly accessible.

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Chapter 5

Assessment of New and Significant Information

5.1 Discussion

NRC

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

NRC regulations do not require an applicant's environmental report to contain analyses of the impacts of Category 1 issues. Nevertheless, the regulations [10 CFR 51.53(c)(3)(iv)] do require that an applicant identify any new and significant information of which the applicant is aware that would negate any of the generic findings that NRC has codified or evaluated in the *Generic Environmental Impact Statement for License Renewal of Nuclear Plants* (GEIS) (NRC 1996a). The purpose of this requirement is to alert NRC staff to such information, so the staff can determine whether to seek the Commission's approval to waive or suspend application of the rule with respect to the affected generic analysis. NRC has explicitly indicated, however, that an applicant is not required to perform a site-specific validation of GEIS conclusions (NRC 1996b).

EGC expects that new and significant information would include:

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

NRC does not specifically define the term "significant". For the purpose of its review, EGC used guidance available in Council on Environmental Quality (CEQ) regulations. The National Environmental Policy Act authorizes CEQ to establish implementing regulations for federal agency use. NRC requires license renewal applicants to provide NRC with input, in the form of an environmental report, that NRC will use to meet National Environmental Policy Act requirements as they apply to license renewal (10 CFR 51.10). CEQ guidance provides that federal agencies should prepare environmental impact statements for actions that would significantly affect the environment (40 CFR 1502.3), focus on significant environmental issues (40 CFR 1502.1), and eliminate from detailed study issues that are not significant [40 CFR 1501.7(a)(3)]. The CEQ guidance includes a lengthy definition of "significantly" that requires consideration of the context of the action and the intensity or severity of the impact(s) (40 CFR 1508.27). EGC expects that moderate or large impacts, as defined by NRC, would be significant. Chapter 4 presents the NRC definitions of "moderate" and "large" impacts.

EGC is aware of no new and significant information regarding the environmental impacts of QCNPS license renewal.

5.2 References

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Chapter 6

Summary of License Renewal Impacts and Mitigating Actions

6.1 License Renewal Impacts

EGC has reviewed the environmental impacts of renewing the QCNPS operating licenses and has concluded that all impacts would be small and would not require mitigation. This environmental report documents the basis for EGC's conclusion. Chapter 4 incorporates by reference NRC findings for the 48 Category 1 issues that apply to QCNPS, all of which have impacts that are small (Table 4-2). The rest of Chapter 4 also analyzes Category 2 issues, all of which are either not applicable or have impacts that would be small. Table 6-1 identifies the impacts that QCNPS license renewal would have on resources associated with Category 2 issues.

6.2 Mitigation

NRC

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

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

All impacts of license renewal are small and would not require mitigation. Current operations include mitigation and monitoring activities that would continue during the term of the license renewal. EGC performs routine mitigation and monitoring activities to ensure the safety of workers, the public, and the environment. These activities include the radiological environmental monitoring program, emissions monitoring, effluent chemistry monitoring, and monitoring the water quality and fishery of the Mississippi River.

6.3 Unavoidable Adverse Impacts

NRC

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

This environmental report adopts by reference NRC findings for applicable Category 1 issues, including discussions of any unavoidable adverse impacts (Table 4-2). EGC examined 21 Category 2 issues and identified the following unavoidable adverse impacts of license renewal:

- Waste heat that results from operation of the Station is discharged to the deep main channel of the Mississippi River and affects its thermal pattern locally. The additional heat loading could cause a small reduction in productivity of fish, phytoplankton, and benthos nearer to the shoreline. The additional heat is released to the atmosphere over the river and slightly increases the consumption of water, due to increased evaporation accompanying the added heat load.

- Disposal of sanitary, chemical, and radioactive wastes have adverse impacts as long as the Station is in operation. Spent nuclear fuel is a product of the operation of the Station and currently has no long-term disposal option.

- Operation of the Station results in a very small increase in radioactivity in the air and water. However, fluctuations in natural radiation background may be expected to exceed the small incremental increase in dose to the local population. Operation also establishes a very low probability risk of accidental radiation exposure to inhabitants of the area.

- Some fish are impinged on the traveling screens at the intake structures.

- Some larval fish and shellfish are entrained at the intake structures.

- For purposes of analysis, EGC assumed that license renewal would require 60 additional workers, which would create an additional 139 indirect jobs. A total of 199 direct and indirect jobs would be created, 153 of these in the three counties in which the majority of workers reside (see Section 4.14). The addition of 153 housing units to the three counties in which the majority of the current QCNPS workers reside would result in small impacts to housing availability, transportation infrastructure, and public utilities that could be characterized as adverse, but would not be significant.

6.4 Irreversible and Irretrievable Resource Commitments

NRC

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

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

- Nuclear fuel, which is consumed in the reactor and converted to radioactive waste
- The land required to dispose of spent nuclear fuel, low-level radioactive wastes generated as a result of plant operations, and solid and sanitary wastes generated from normal industrial operations
- Elemental materials that will become radioactive, and
- Materials used for the normal industrial operations of the Station that cannot be recovered or recycled or that are consumed or reduced to unrecoverable forms.

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

NRC

The environmental report shall discuss... "[t]he relationship between local short-term uses of man's environment and the maintenance and enhancement of long-term productivity...." 10 CFR 51.45(b)(4) as adopted by 10 CFR 51.53(c)(2)

The current balance between short-term use and long-term productivity at QCNPS was established when the Station began operating in the early 1970s. The QCNPS Final Environmental Statement (AEC 1972) evaluated the impacts of constructing and operating QCNPS in rural Rock Island County, Illinois. Approximately 560 acres were acquired for the Station, a subsequent spray-canal system, transmission line rights-of-way, and buffer areas. At that time, the property was a relatively undeveloped section of the Mississippi River that had somewhat lower agricultural productivity than the general region.

The city of Cordova, Illinois, had been promoting the area north of the city for industrial use. QCNPS and the industrial park north of the Station are a direct result of this effort. After Station operations cease, the QCNPS site could be used for other industrial purposes. Long-term productivity of the terrestrial and aquatic habitats in the vicinity of QCNPS is not adversely affected by the Station. Continued operations for an additional 20 years would not alter this conclusion.

Table 6-1. Environmental Impacts Related to License Renewal at QCNPS.

No.	Issue	Environmental Impact
	Surface Water Quality, Hydrology, and Use (for all plants)	
13	Water use conflicts (plants with cooling ponds or cooling towers using make-up water from a small river with low flow)	**None.** QCNPS operates with a once-through cooling system. Therefore, this issue does not apply.
	Aquatic Ecology (for plants with once-through and cooling pond heat dissipation systems)	
25	Entrainment of fish and shellfish in early life stages	**Small.** QCNPS has a current NPDES permit which constitutes compliance with CWA Section 316(b) requirements.
26	Impingement of fish and shellfish in early life stages	**Small.** QCNPS has a current NPDES permit which constitutes compliance with CWA Section 316(b) requirements.
27	Heat shock	**Small.** QCNPS has a current NPDES permit which constitutes compliance with CWA Section 316(a) requirements.
	Groundwater Use and Quality	
33	Groundwater use conflicts (potable and service water, and dewatering; plants that use > 100 gpm)	**Small.** Monitoring has indicated that even during periods of higher than normal groundwater withdrawal, offsite wells have not been affected.
34	Groundwater use conflicts (plants using cooling towers or cooling ponds that withdraw make-up water from a small river)	**None.** QCNPS does not use cooling ponds or cooling towers. Therefore, this issue does not apply.
35	Groundwater use conflicts (Ranney wells)	**None.** This issue does not apply because QCNPS does not use Ranney wells.
39	Groundwater quality degradation (cooling ponds at inland sites)	**None.** QCNPS does not use a cooling water pond. Therefore, this issue does not apply.
	Terrestrial Resources	
40	Refurbishment impacts	**None.** No impacts are expected because QCNPS will not undertake refurbishment.
	Threatened or Endangered Species	
49	Threatened or endangered species	**Small.** EGC is not aware of any resident threatened or endangered species at QCNPS or along associated transmission corridors.
	Air Quality	
50	Air quality during refurbishment (nonattainment and maintenance areas)	**None.** No impacts are expected because QCNPS will not undertake refurbishment.
	Human Health	
57	Microbiological organisms (plants using lakes or canals, or cooling towers or cooling ponds that discharge to a small river)	**Small.** The thermal characteristics of the Mississippi River near the QCNPS discharge and the absence of a seed source or inoculant are such that Station operations should not stimulate growth or reproduction of thermophilic organisms.

Table 6-1. Environmental Impacts Related to License Renewal at QCNPS (Continued).

No.	Issue	Environmental Impact
59	Electromagnetic fields – acute effects	**Small.** The largest modeled induced current under the QCNPS transmission lines is 6 milliamperes, which is only nominally greater than the National Electric Safety Code standard of 5 milliamperes for preventing electric shock from induced current.
	Socioeconomics	
63	Housing impacts	**Small.** QCNPS is located in a medium-population area that does not have growth control measures. Therefore, in accordance with NRC standards, housing impacts would be small
65	Public services: public utilities	**Small.** Any increase in public water requirements from a potential 199 new households would not impinge on the water supplies of the affected communities.
66	Public services: education (refurbishment)	**None.** No impacts are expected because QCNPS will not undertake refurbishment.
68	Offsite land use (refurbishment)	**None.** No impacts are expected because QCNPS will not undertake refurbishment
69	Offsite land use (license renewal term)	**Small.** No plant-induced changes to offsite land use are expected from license renewal. Impacts from continued operation would be positive.
70	Public services: transportation	**Small.** Any additional employees (up to 60) would be less than the typical refueling outage workforce of 1,100 additional employees. Existing access roads are adequate to support this outage traffic
71	Historic and archaeological resources	**Small.** Continued operation of QCNPS would not require construction at the site or new transmission lines. Therefore, EGC concludes that license renewal would not adversely affect historic or archaeological resources
	Postulated Accidents	
76	Severe accidents	**Small.** The benefit/cost analysis identified no severe accident mitigation alternatives that would avert public risk.

6.6 References

AEC (U.S. Atomic Energy Commission), 1972. *Final Environmental Statement related to the Operation of Quad Cities Nuclear Station Units 1 & 2*, Docket Nos. 50-254 and 50-265, Directorate of Licensing, Washington, DC, September.

Chapter 7

Alternatives to the Proposed Action

Appendix F - Quad Cities Nuclear Power Station Environmental Report

NRC

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

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

"While many methods are available for generating electricity, and a huge number of combinations or mixes can be assimilated to meet a defined generating requirement, such expansive consideration would be too unwieldy to perform given the purposes of this analysis. Therefore, NRC has determined that a reasonable set of alternatives should be limited to analysis of single, discrete electric generation sources and only electric generation sources that are technically feasible and commercially viable." (NRC 1996a, Section 8.1).

"...The consideration of alternative energy sources in individual license renewal reviews will consider those alternatives that are reasonable for the region, including power purchases from outside the applicant's service area...." (NRC 1996b, Section II.H, pg. 66541, column 3).

Introduction

Chapter 7 addresses alternatives to QCNPS license renewal. The chapter evaluates what might happen if NRC did not renew the Station operating licenses: what alternative actions might be undertaken, which alternatives are not reasonable and why and, for reasonable alternatives, what the associated environmental impacts might be. Chapter 8 compares these impacts to those associated with license renewal.

In determining the level of detail and analysis that it should provide in Chapter 7, EGC relied on the NRC decision-making standard for license renewal:

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

EGC has determined that the environmental report would support NRC decision making as long as the document provides sufficient information to clearly indicate whether an alternative would have a smaller, comparable, or greater environmental impact than the proposed action. Providing additional detail or analysis serves no function if it only brings to light, for example, additional adverse impacts of alternatives to license renewal. This approach is consistent with regulations of the Council on Environmental Quality, which provide that the consideration of alternatives (including the proposed action) should enable reviewers to evaluate their comparative merits (40 CFR 1500-1508). EGC believes that Chapter 7 provides sufficient detail about alternatives to establish the basis for

necessary comparisons to the Chapter 4 discussion of impacts from the proposed action.

7.1 No-Action Alternative

7.1.1 DECOMMISSIONING

Regardless of whether NRC renews the QCNPS operating licenses, and regardless of which alternatives are undertaken should NRC not renew the licenses, EGC must comply with NRC requirements for decommissioning a nuclear power plant.

The *Generic Environmental Impact Statement* (GEIS) (NRC 1996a) defines decommissioning as the safe removal of a nuclear facility from service and the reduction of residual radioactivity to a level that permits release of the property for unrestricted use and termination of the license. NRC-evaluated decommissioning options include immediate decontamination and dismantlement (DECON), and safe storage of the stabilized and defueled facility (SAFSTOR) for a period of time, followed by decontamination and dismantlement. Regardless of the option chosen, decommissioning must be completed within a 60-year period. Under the no-action alternative, EGC would continue operating QCNPS until the current license expires, then initiate decommissioning activities in accordance with NRC requirements.

The GEIS describes decommissioning activities based on an evaluation of an example reactor (the "reference" boiling water reactor is the 1,155-megawatts-electrical (MWe) Energy Northwest's Columbia plant (formerly Washington Public Power Supply System's WNP-2 plant). This description is comparable to decommissioning activities that EGC would conduct at QCNPS, although EGC notes that the QCNPS units are smaller than the referenced reactor.

As the GEIS notes, NRC has evaluated environmental impacts from decommissioning. NRC-evaluated impacts include occupational and public radiation dose, impacts of waste management, impacts to air and water quality, ecological, economic, and socioeconomic impacts. In its GEIS on decommissioning, NRC indicated that the environmental effects of greatest concern (i.e., radiation dose and releases to the environment) are substantially less than the same effects resulting from reactor operations (NRC 1988). EGC adopts by reference the NRC conclusions regarding environmental impacts of decommissioning.

EGC notes that decommissioning activities and their impacts are not discriminators between the proposed action and the no-action alternative. EGC will have to decommission QCNPS; license renewal would only postpone decom-missioning for another 20 years. NRC has established in the GEIS that the timing of decommissioning operations does not substantially influence the environmental impacts of decommissioning. EGC adopts by reference NRC findings (10 CFR 51 Appendix B, Table B-1, Decom-missioning) to the effect that delaying decommissioning until after the renewal term would have small environmental impacts. The discriminators between the proposed action and the no-action alternative lie within the choice of options for replacing QCNPS capacity. Section 7.2.2 analyzes the impacts from these options.

EGC concludes that the decommissioning impacts under the no-action alternative would not be substantially different from those occurring following license renewal, as identified in the GEIS (NRC 1996a) and in the decommissioning generic environmental impact statement (NRC 1988). These impacts would be temporary and would occur at the same time as the impacts from meeting system generating needs.

7.1.2 REPLACEMENT CAPACITY

In 2000, QCNPS provided approximately 12.4 terawatt hours of electricity (EIA 2001a, Illinois, Quad Cities). A terawatt hour is one billion kilowatt hours. This is approximately 14 percent of the energy generated by nuclear power that EGC provides to its 3.5 million customers in Illinois (ComEd 2000). QCNPS' capacity provides electricity for approximately 350,000 industries, commercial establishments, and residences. EGC believes that any alternative would be unreasonable if it did not include replacing this capacity. Replacement could be accomplished by (1) building new generating capacity, (2) purchasing power from outside the EGC system, or (3) reducing power requirements through demand reduction. Section 7.2.1 describes each of these possibilities in detail, and Section 7.2.2 describes environmental impacts from feasible alternatives.

7.2 Alternatives that Meet System Generating Needs

7.2.1 ALTERNATIVES CONSIDERED

7.2.1.1 Technology Choices

The current mix of power generation options in Illinois is one indicator of the feasible choices for electric generation technology within the State. EGC evaluated Illinois' electric generation capacity and utilization characteristics using statistics from 1999, the most recent year for which a complete set of data is available. "Capacity" is the quantification of the various installed technology choices. "Utilization" is the degree to which each choice is actually used.

In 1999, Illinois' electric industry had a total generating capacity of 34,338 megawatts-electric. As Figure 7-1 indicates, this capacity includes units fueled by coal (46.7 percent); nuclear (31.2 percent); gas (15.7 percent); oil (3.2 percent); dual (e.g., oil/gas)-fired (0.9 percent), hydroelectric (0.1 percent), and other (2.3 percent) (EIA 2001b, Table 4).

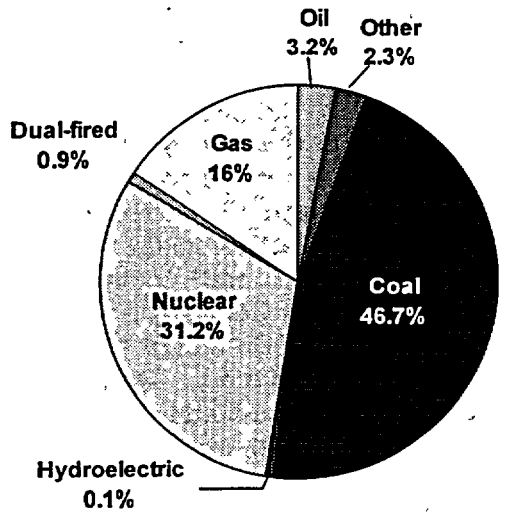

Figure 7-1. Illinois Electric Industry Generating Capacity, 1999

Based on 1999 generation data, Illinois' electric industry provided approximately 164 terawatt hours of electricity. As Figure 7-2 depicts, Illinois' generation utilization was primarily from nuclear (50 percent), followed by coal (45.3 percent), gas (3.4 percent), oil (0.5 percent), other (0.7 percent), and hydroelectric (0.1 percent) (EIA 2001b, Table 5).

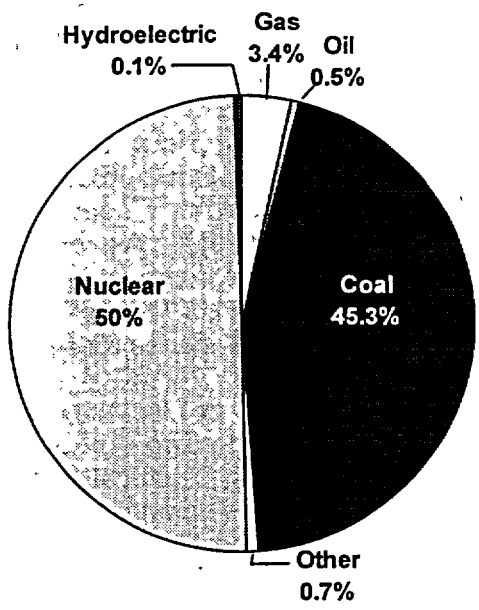

Figure 7-2. Illinois Electric Industry Generation Utilization, 1999

The difference between capacity and utilization is the result of preferential usage. For example, in 1999 nuclear energy represented 31.2 percent of Illinois' installed capability, but produced 50 percent of the electricity generated (EIA 2001b, Tables 4 and 5, respectively). This reflects Illinois' preferential reliance on nuclear energy as a base-load generating source.

7.2.1.2 Effects of Deregulation

Efforts to deregulate the electric utility industry began with passage of the National Energy Policy Act of 1992. Provisions of this Act required electric utilities to allow open access to their transmission lines and encouraged development of a competitive wholesale market for electricity. The Act did

not mandate competition in the retail market, leaving that decision to the states (NEI 2000).

In December 1997, the State of Illinois began the process of restructuring the retail market (i.e., deregulation) by enacting the Illinois Electric Service Customer Choice and Rate Relief Act of 1997 (also known as the Illinois Electricity Choice Law). The Act eliminates regulated generation service areas and enables all customers of electric distribution companies in the State to purchase electricity from their choice of electric generation suppliers by May 1, 2002. Electric generation supply will be based on customers' needs and preferences (ICC 1999). As discussed below, this injection of competition among electric generators affects the selection of alternatives for QCNPS license renewal.

Before Illinois enacted its Electricity Choice Law, decisions regarding reasonable alternatives for meeting electrical demands in Illinois were made primarily by two entities, utilities and the Illinois Commerce Commission. As a result of the Law, the Illinois Commerce Commission no longer has a formal role in assessing Illinois' electricity needs or mandating additional capacity. Instead, market forces are expected to spur innovation, attract competition, drive the appropriate supply/demand balance, and attract new power suppliers to the State (IPCB 2000). Therefore, generators of electric power in the State of Illinois are solely responsible for decisions regarding reasonable alternatives for meeting electrical demands.

Since the Illinois Electricity Choice Law was enacted, the Illinois Environmental Protection Agency has received more than 60 applications for construction of new generating facilities. Citizens, local governments, and legislators objected to several of the proposed plants. In response, the Illinois Pollution Control Board conducted hearings to evaluate whether additional siting requirements or other regulation of such proposed plants should be recommended. The Illinois Pollution Control Board recommended that the Illinois Environmental Protection Agency adopt new rules that would tighten restrictions on air emissions and require public participation in the construction permit process, but deferred to the Governor's Office for a decision regarding requirements for siting new generating facilities (IPCB 2000).

It is not clear whether EGC or another supplier would construct new generating units to replace those at QCNPS, if its licenses were not renewed. However, regardless of which entities construct and operate the replacement power supply, certain environmental parameters would be constant among these alternative power sources. Therefore, Chapter 7 discusses the impacts of reasonable alternatives to QCNPS license renewal without regard to whether they would be implemented by EGC.

7.2.1.3 Mixture

NRC indicated in the GEIS that, while many methods are available for generating electricity and a huge number of combinations or mixes can be assimilated to meet system needs, such expansive consideration would be too unwieldy given the purposes of the alternatives analysis. Therefore, NRC determined that a reasonable set of alternatives should be limited to analysis of single discrete electrical generation sources and only those electric generation technologies that are technically reasonable and commercially viable (NRC 1996a). Consistent with the NRC determination, EGC has not evaluated mixes of generating sources. The impacts from coal- and gas-fired generation presented in this chapter would bound the impacts from any generation mixture of the two technologies.

7.2.1.4 Fossil-Fuel-Fired Generation

EGC analyzed locating hypothetical new coal- and gas-fired units at the existing QCNPS site. Using an existing site could minimize environmental impacts by building on previously disturbed land and by making the most use possible of existing facilities such as transmission lines, roads and parking areas, office buildings, and the cooling system. Locating hypothetical units at the existing site has, therefore, been applied to the coal-and gas-fired units.

EGC notes that the U.S. Environmental Protection Agency has revised requirements that could affect the design of cooling water intake structures for new facilities (EPA 2001) and has proposed requirements that could affect modifications at existing facilities (EPA 2002a). These requirements could necessitate construction of cooling towers for the coal- and gas-fired alternatives if surface water were used for cooling.

It must be emphasized that these are hypothetical scenarios. EGC does not have plans for such construction at the QCNPS site.

Coal-Fired Generation

NRC has evaluated coal-fired generation alternatives for the Calvert Cliffs Nuclear Power Plant (NRC 1999a) and for the Oconee Nuclear Station (NRC 1999b). For Oconee, NRC analyzed 2,500 MWe of coal-fired generation capacity. EGC has reviewed the NRC analysis, believes it to be sound, and notes that it analyzed substantially more generating capacity than the 1,824 MWe discussed in this analysis. In defining the QCNPS coal-fired alternative, EGC has used site- and Illinois-specific input and has scaled from the NRC analysis, where appropriate.

EGC defined the QCNPS coal-fired alternative as consisting of three 550-MWe units. EGC chose this configuration to be equivalent to the gas-fired alternative described below. This equivalency makes impact characteristics most comparable, facilitating impact analysis

Table 7-1 describes assumed basic operational characteristics of the coal-fired units. EGC based its emission control technology and percent-control assumptions on alternatives that the U.S. Environmental Protection Agency (EPA) has identified as being available for minimizing emissions (EPA 1998). For the purposes of analysis, EGC has assumed that coal and lime (calcium oxide) would be delivered by rail after upgrading the existing rail spur into QCNPS.

Gas-Fired Generation

EGC has chosen to evaluate gas-fired generation, using combined-cycle turbines, because it has determined that the technology is mature, economical, and feasible. A scenario, for example, of three units with a net capacity of 608 MWe could be assumed to replace the 1,824-MWe QCNPS total net capacity. However, EGC's experience indicates that, although customized unit sizes can be built, using standardized sizes is more economical. Existing manufacturers' standard-sized units include a gas-fired combined-cycle plant of 550-MWe net capacity, consisting of two 184-MWe gas turbines and 182 MWe of heat recovery capacity (e.g., General Electric Frame 7FA).

EGC assumed three 550-MWe units, having a total capacity of 1,650 MWe, as the gas-fired alternative at the QCNPS site. Although this provides less capacity than the existing unit (1,650 MWe for this alternative versus 1,824 MWe for existing capacity), it ensures against overestimating environmental impacts from the alternatives. The shortfall in capacity could be replaced by other methods, such as importing power. However, for the reasons discussed in Section 7.2.1.3, EGC did not analyze a

mixture of these alternatives and imported power.

Table 7-2 describes assumed basic operational characteristics of the gas-fired units. As for the coal-fired alternative, EGC based its emission control technology and percent-control assumptions on alternatives that the EPA has identified as being available for minimizing emissions (EPA 1998). For the purposes of analysis, EGC has assumed that it would ensure gas availability through its parent company, Exelon Corporation.

7.2.1.5 Purchased Power

In a traditional alternatives analysis for utility generation capacity, the purchased power alternative meant that the utility would meet a portion of its service area demand using power that it purchased from another utility. Deregulation, however, is changing this traditional analysis. First, the end-user could purchase electricity from another entity (in this case, from a company other than EGC). Second, EGC expects retail competition to decrease generators' incentives to provide wholesale power to competing companies such as EGC for resale, thus reducing the availability of power for EGC to purchase and resell competitively.

EGC has evaluated conventional and prospective power supply options that could be reasonably implemented before the current QCNPS license expires. In 1999, Unicom completed the sale of its ComEd fossil-fuel-fired coal, gas, and oil units to Midwest Generation. As part of the sale, Unicom (now Exelon) entered into long-term purchase contracts with Midwest Generation to provide firm capacity and energy (ComEd 1999). Because these contracts are part of EGC's current and future capacity, however, EGC does not consider these power purchases to be a feasible option for the purchased power alternative.

Illinois is a net exporter of power; in 1999, Illinois exported 76 terawatt-hours of electricity (EIA 2001c). While some of these exports may be the result of contracts that would prevent use to replace QCNPS generation, EGC cannot rule out the possibility that power would be available for purchase as an alternative to QCNPS license renewal. Therefore, EGC has analyzed purchased power as a reasonable alternative.

EGC assumes that the generating technology used to produce purchased power would be one of those that NRC analyzed in the GEIS. For this reason, EGC is adopting by reference the GEIS description of the alternative generating technologies as representative of the purchased power alternative.

7.2.1.6 Demand-Side Management

Historically, state regulatory bodies have required regulated utilities to institute programs designed to reduce demand for electricity. Demand-side management (DSM) programs included energy conservation and load modification measures. In the current deregulated Illinois market, EGC anticipates that it will not be able to offer competitively priced power if it retains an extensive conservation and load-modification-incentive program. However, EGC has evaluated the DSM alternative because future legislation could require such measures.

In the past, Exelon (then ComEd) offered DSM programs that either conserved energy or allowed the Company to reduce customers' load requirements during periods of peak demand. Exelon's DSM programs fell into the following categories:

Conservation Programs

- Educational programs that encouraged the wise use of energy

Energy Efficiency Programs

- Discounted residential rates for Good Cents homes and homes that met specific energy efficiency standards
- Free Home Energy Audit Program that provided residential energy audits and encouraged efficiency upgrades
- Incentive Programs that encouraged customers to replace old, inefficient appliances or equipment with new high-efficiency appliances or equipment
- Government Partnerships that assisted federal facilities in meeting mandated energy efficiency goals through design and installation of high-efficiency lighting systems and computerized energy management.

Load Management Programs

- Standby Generator Program – encouraged customers to let Exelon switch loads to the customer's standby generators during periods of peak demand
- Interruptible Service Program – encouraged customers to allow blocks of their load to be interrupted during periods of peak demand
- Real Time Pricing – encouraged customers to discontinue usage during specific times

EGC annually projects both the summer and winter peak power, annual energy requirements, and impacts of DSM. Projections for future DSM show substantial decreases in DSM initiatives that were in effect during past years. Market conditions, which provided the initial support for utility-sponsored conservation and load management efforts during the late 1970s and early 1980s, can be broadly characterized by:

- Increasing long-term marginal prices for capacity and energy production resources
- Forecasts projecting increasing demand for electricity across the nation
- General agreement that conditions (1) and (2) would continue for the foreseeable future
- Limited competition in the generation of electricity
- Economies of scale in the generation of electricity, which supported the construction of large central power plants, and
- The use of average embedded cost as the basis for setting electricity prices within a regulated context.

These market and regulatory conditions would undergo dramatic changes in a deregulated market. Changes that have significantly impacted the cost effectiveness of utility-sponsored DSM, can be described as follows:

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

Consistent with (1) and (2) above, the utility planning environment features lower capacity and lower energy prices than during earlier periods, shorter planning horizons, lower reserve margins, and increased reliance on market prices to direct utility resource planning. These have greatly reduced the number of cost-effective DSM alternatives.

Other significant changes include the following.

- The adoption of increasingly stringent national appliance standards for most major energy-using equipment and the adoption of energy efficiency requirements in state building codes. These mandates have further reduced the potential for cost-effective utility-sponsored measures.

- In states that are currently transitioning into deregulation, third parties are increasingly providing energy services and products in competitive markets at prices that reflect their value to the customer. Market conditions can be expected to continue this shift among providers of cost-effective load management.

For these reasons, EGC determined that the remaining DSM programs, which are primarily directed toward load management, are not an effective substitute for any of its large base-load units such as QCNPS that operate at high capacity factors.

7.2.1.7 Other Alternatives

This section identifies alternatives that EGC has determined are not reasonable and the EGC basis for this determination. EGC accounted for the fact that QCNPS is a base-load generator and that any feasible alternative to QCNPS would also need to be able to generate base-load power. In performing this evaluation, EGC relied heavily upon NRC's GEIS (NRC 1996a).

Wind

Wind power, by itself, is not suitable for large base-load capacity. As discussed in Section 8.3.1 of the GEIS, wind has a high degree of intermittence, and average annual capacity factors for wind plants are relatively low (less than 30 percent). Wind power, in conjunction with energy storage mechanisms, might serve as a means of providing base-load power. However, current energy storage technologies are too expensive for wind power to serve as a large base-load generator.

According to the Wind Energy Resource Atlas of the United States, areas suitable for wind energy applications must be wind power class 3 or higher. Approximately eight percent of the land area in Illinois has a wind power classification of three or higher. However, land-use conflicts such as urban development, farmland, and environmentally sensitive areas reduce the amount of land suitable for wind energy applications to about five percent of the land area in Illinois, mostly in the west-central uplands (NREL 1986).

The GEIS estimates a land use of 150,000 acres per 1,000 MWe for wind power. Therefore, replacement of QCNPS generating capacity with wind power, even assuming ideal wind conditions, would require dedication of about 430 square miles. Based on the lack of sufficient wind speeds and the amount of land needed to replace QCNPS, the wind alternative would require a large greenfield site, which would result in a large environmental impact. Additionally, wind plants have aesthetic impacts, generate noise, and harm birds.

EGC has concluded that, due to the limited availability of area in Illinois having suitable wind speeds and also due to the amount of land needed (approximately 430 square miles), wind power is not a reasonable alternative to QCNPS license renewal.

Solar

By its nature, solar power is intermittent. In conjunction with energy storage mechanisms, solar power might serve as a means of providing base-load power. However, current energy storage technologies are too expensive to permit solar power to serve as a large base-load generator. Even without storage capacity, solar power technologies (photovoltaic and

thermal) cannot currently compete with conventional fossil-fueled technologies in grid-connected applications, due to high costs per kilowatt of capacity. (NRC 1996a).

Solar power is not a technically feasible alternative in EGC's service area. Western Illinois receives about 3.5 kilowatt hours of solar radiation per square meter per day, compared with 5 to 7.2 kilowatt hours per square meter per day in areas of the West, such as California, which are most promising for solar technologies (NRC 1996a).

Finally, according to the GEIS, land requirements for solar plants are high, at 35,000 acres per 1,000 MWe for photovoltaic and 14,000 acres per 1,000 MWe for solar thermal systems. Therefore, replacement of QCNPS generating capacity with solar power would require dedication of about 100 square miles for photovoltaic and 40 square miles for solar thermal systems. Neither type of solar electric system would fit at the QCNPS site, and both would have large environmental impacts at a greenfield site.

EGC has concluded that, due to the high cost, limited availability of sufficient incident solar radiation, and amount of land needed (approximately 40 to 100 square miles), solar power is not a reasonable alternative to QCNPS license renewal.

Hydropower

A small portion (about 80 MW) of Illinois utility generating capacity is hydroelectric. As the GEIS points out in Section 8.3.4, hydropower's percentage of United States generating capacity is expected to decline because hydroelectric facilities have become difficult to site as a result of public concern over flooding, destruction of natural habitat, and destruction of natural river courses. According to the *U.S. Hydropower Resource Assessment for Illinois* (INEL 1997), there are no remaining sites in Illinois that would be environmentally suitable for a large hydroelectric facility.

The GEIS (Section 8.3.4) estimates land use of 1,600 square miles per 1,000 MWe for hydroelectric power. Based on this estimate, replacement of QCNPS generating capacity would require flooding more than 2,900 square miles. This would result in a large impact on land use. Further, operation of a hydroelectric facility would alter aquatic habitats above and below the dam, which would impact existing aquatic species.

EGC has concluded that, due to the lack of suitable sites in Illinois and the amount of land needed (approximately 2,900 square miles), hydropower is not a reasonable alternative to QCNPS license renewal.

Geothermal

As illustrated by Figure 8.4 in the GEIS, geothermal plants might be located in the western continental United States, Alaska, and Hawaii, where hydrothermal reservoirs are prevalent. However, because there are no high-temperature geothermal sites in Illinois, EGC concludes that geothermal is not a reasonable alternative to QCNPS license renewal.

Wood Energy

The use of wood waste to generate electricity is largely limited to those states with significant wood resources, such as California, Maine, Georgia, Minnesota, Oregon, Washington, and Michigan. Electric power is generated in these states by the pulp, paper, and paperboard industries, which consume wood and wood waste for energy, benefiting from the use of waste materials that could otherwise represent a disposal problem. However, the largest wood waste power plants are 40 to 50 MW in size.

Further, as discussed in Section 8.3.6 of the GEIS, construction of a wood-fired plant

would have an environmental impact that would be similar to that for a coal-fired plant, although facilities using wood waste for fuel would be built on smaller scales. Like coal-fired plants, wood-waste plants require large areas for fuel storage, processing, and waste disposal (i.e., ash). Additionally, operation of wood-fired plants has environmental impacts, including impacts on the aquatic environment and air.

EGC has concluded that, due to the lack of significant wood resources in Illinois and the lack of an obvious environmental advantage, wood energy is not a reasonable alternative to QCNPS license renewal.

Municipal Solid Waste

As discussed in Section 8.3.7 of the GEIS, the initial capital costs for municipal solid waste plants are greater than for comparable steam turbine technology at wood-waste facilities. This is due to the need for specialized waste separation and handling equipment.

The decision to burn municipal solid waste to generate energy is usually driven by the need for an alternative to landfills, rather than by energy considerations. The use of landfills as a waste disposal option is likely to increase in the near term; however, it is unlikely that many landfills will begin converting waste to energy because of unfavorable economics, particularly with electricity prices declining.

Estimates in the GEIS suggest that the overall level of construction impacts from a waste-fired plant should be approximately the same as that for a coal-fired plant. Additionally, waste-fired plants have the same or greater operational impacts (including impacts on the aquatic environment, air, and waste disposal). Some of these impacts would be moderate, but still larger than the environmental effects of QCNPS license renewal.

EGC has concluded that, due to the high costs and lack of obvious environmental advantages, burning municipal solid waste to generate electricity is not a reasonable alternative to QCNPS license renewal.

Other Biomass-Derived Fuels

In addition to wood and municipal solid waste fuels, there are several other concepts for fueling electric generators, including burning energy crops, converting crops to a liquid fuel such as ethanol (ethanol is primarily used as a gasoline additive), and gasifying energy crops (including wood waste). As discussed in Section 8.3.8 of the GEIS, none of these technologies has progressed to the point of being competitive on a large scale or of being reliable enough to replace a base-load plant such as QCNPS.

Further, estimates in the GEIS suggest that the overall level of construction impacts from a crop-fired plant should be approximately the same as that for a wood-fired plant. Additionally, crop-fired plants would have similar operational impacts (including impacts on the aquatic environment and air). In addition, these systems have large impacts on land use, due to the acreage needed to grow the energy crops.

EGC has concluded that, due to the high costs and lack of obvious environmental advantage, burning other biomass-derived fuels is not a reasonable alternative to QCNPS license renewal.

Oil

Illinois has several oil-fired units; however, they produce less than one percent of the State's power generation. The cost of oil-fired operation is more expensive than nuclear or coal-fired operation. In addition, future increases in oil prices are expected to make oil-fired generation increasingly more expensive than coal-fired generation. The high cost of oil has prompted a steady

decline in its use for electricity generation. From 1997 to 1998, production of electricity by oil-fired plants dropped by about 39.9 percent in Illinois (EIA 1998).

Also, construction and operation of an oil-fired plant would have environmental impacts. For example, Section 8.3.11 of the GEIS estimates that construction of a 1,000-MWe oil-fired plant would require about 120 acres. Additionally, operation of oil-fired plants would have environmental impacts (including impacts on the aquatic environment and air) that would be similar to those from a coal-fired plant.

EGC has concluded that, due to the high costs and lack of obvious environmental advantage, oil-fired generation is not a reasonable alternative to QCNPS license renewal.

Fuel Cells

Phosphoric acid fuel cells are the most mature fuel cell technology, but they are only in the initial stages of commercialization. Two hundred turnkey plants have been installed in the United States, Europe, and Japan. Recent estimates suggest that a company would have to produce about 100 MW of fuel cell stacks annually to achieve a price of $1,000 to $1,500 per kilowatt. However, the current production capacity of all fuel cell manufacturers only totals about 75 MW per year. EGC believes that this technology has not matured sufficiently to support production for a facility the size of QCNPS. EGC has concluded that, due to the cost and production limitations, fuel-cell technology is not a reasonable alternative to QCNPS license renewal.

Delayed Retirement

EGC has no plans for retiring any reactors in its fleet of nuclear plants and expects to need additional capacity in the near future. Fossil plants slated for retirement tend to utilize less efficient generation and pollution control technologies. In the face of increasingly stringent restrictions, delaying retirement in order to compensate for a plant the size of QCNPS would appear to be unreasonable without major construction to upgrade or replace plant components. EGC concludes that the environmental impacts of such a scenario are bounded by its coal- and gas-fired alternatives.

7.2.2 ENVIRONMENTAL IMPACTS OF ALTERNATIVES

This section evaluates the environmental impacts from what EGC has determined to be reasonable alternatives to QCNPS license renewal: coal-fired generation, gas-fired generation, and purchased power.

In characterizing environmental impacts from alternatives, EGC has used the same definitions of "small," "moderate," and "large" that are presented in the Chapter 4 Introduction.

7.2.2.1 Coal-Fired Generation

NRC evaluated environmental impacts from coal-fired generation alternatives in the GEIS (NRC 1996a) and concluded that construction impacts could be substantial, due in part to the large land area required (which can result in natural habitat loss) and the large workforce needed. NRC pointed out that siting a new coal-fired plant where an existing nuclear plant is located would reduce many construction impacts. NRC identified major adverse impacts from operations as human health concerns associated with air emissions, waste generation, and losses of aquatic biota due to cooling water withdrawals and discharges.

The coal-fired alternative defined by EGC in Section 7.2.1.4 would be located at QCNPS.

Air Quality

Air quality impacts of coal-fired generation are considerably different from those of nuclear power. A coal-fired plant would emit sulfur dioxide (SO_2, as SO_x surrogate), oxides of nitrogen (NO_x), particulate matter (PM), and carbon monoxide (CO), all of which are regulated pollutants. As Section 7.2.1.4 indicates, EGC has assumed a plant design that would minimize air emissions through a combination of boiler technology and post-combustion pollutant removal. EGC estimates the coal-fired alternative emissions to be as follows:

SO_x = 6,605 tons per year

NO_x = 1,721 tons per year

CO = 1,721 tons per year

PM = 238 tons per year

PM_{10} (particulates having a diameter of less than 10 microns) = 55 tons per year

Table 7-3 shows how EGC calculated these emissions.

Coal combustion also results in low emissions of heavy metals such as mercury, hazardous air pollutants such as benzene, polychlorinated dibenzo-p-dioxins, and polychlorinated dibenzofurans.

In 1999, emissions of SO_2 and NO_x from Illinois' generators ranked 7th and 4th nationally, respectively (EIA 2001b). Seventeen Illinois generators were cited in the Clean Air Act Amendments of 1990 to begin compliance in 1995 with stricter emission controls for SO_2 and NO_x. The acid rain requirements of the Clean Air Act Amendments capped the nation's SO_2 emissions from power plants. Each company having fossil-fuel-fired units was allocated SO_2 allowances. To be in compliance with the Act, the companies must hold enough allowances to cover their annual SO_2 emissions. EGC, having no fossil units, would have to purchase allowances from the open market to operate a fossil-fuel-burning plant at QCNPS. A company that has fossil units might also have the option of shutting down existing capacity and applying credits from that plant to the new one.

To operate a fossil-fuel-fired plant at the QCNPS site, EGC would have to obtain enough NO_x credits to cover annual emissions either from the set-aside pool or by buying NO_x credits from other sources.

In October 1998, EPA promulgated the NO_x State Implementation Plan Call regulation that requires 22 states, including Illinois, to reduce their NO_x emissions by over 30 percent to address regional ozone transport (EPA 2002b). The regulation imposes a NO_x "budget" to limit the NO_x emissions from each state. The Illinois Environmental Protection Agency allocated NO_x credits among the existing electric generating units in the State (IAC 2000). Beginning May 31, 2004, each electric generating unit must hold enough NO_x credits to cover its annual NO_x emissions. A small percentage of NO_x credits was set aside for new sources.

NRC did not quantify coal-fired emissions, but implied that air impacts would be substantial. NRC noted that adverse human health effects from coal combustion have led to important federal legislation in recent years and that public health risks, such as cancer and emphysema, have been associated with coal combustion. NRC also mentioned global warming and acid rain as potential impacts. EGC concludes that federal legislation and large-scale concerns, such as global warming and acid rain, are indications of concerns about destabilizing important attributes of air resources. However, SO_2 emission allowances, NO_x emission offsets, low NO_x burners, overfire air, fabric filters or electrostatic precipitators, and scrubbers are regulatorily imposed mitigation measures. As such, EGC concludes that the coal-fired alternative would have moderate impacts on air quality;

the impacts would be clearly noticeable, but would not destabilize air quality in the area.

Waste Management

EGC concurs with the GEIS assessment that the coal-fired alternative would generate substantial solid waste. The coal-fired plant, using coal with an ash content of 6.9 percent, would annually consume approximately 6,900,000 tons of coal (Table 7-3). Particulate control equipment would collect most (99.9 percent) of this ash, approximately 475,000 tons per year. Illinois regulations encourage recycling of coal-combustion by-products, and EGC (then ComEd) historically recycled 87 percent of its coal ash (ComEd 2000). Assuming continuation of this waste mitigation measure, the coal-fired alternative would generate approximately 62,000 tons of ash per year for disposal.

SO_x-control equipment, annually using nearly 116,000 tons of calcium oxide, would generate another 343,000 tons per year of waste in the form of scrubber sludge. EGC estimates that ash and scrubber waste disposal over a 40-year plant life would require approximately 180 acres (a square area with sides of approximately 2,820 feet). While only half this waste volume and land use would be attributable to the 20-year license renewal period alternative, the total numbers are pertinent as a cumulative impact. Table 7-4 shows how EGC calculated ash and scrubber waste volumes.

EGC believes that, with proper siting coupled with current waste management and monitoring practices, waste disposal would not destabilize any resources. There would be space within the site footprint for this disposal. After closure of the waste site and revegetation, the land would be available for other uses. For these reasons, EGC believes that waste disposal for the coal-fired alternative would have moderate impacts; the impacts of increased waste disposal/ would be clearly noticeable, but would not destabilize any important resource and further mitigation would be unwarranted.

Other Impacts

Construction of the powerblock and coal storage area would impact approximately 300 acres of land and associated terrestrial habitat. Because most of this construction would be in previously disturbed areas, impacts would be minimal. Visual impacts would be consistent with the industrial nature of the site. As with any large construction project, some erosion and sedimentation and fugitive dust emissions could be anticipated, but would be minimized by using best management practices. Construction debris from clearing and grubbing could be disposed of onsite and municipal waste disposal capacity would be available. Socioeconomic impacts would result from the decrease in operational workforce from 854 permanent employees at QCNPS to approximately 250 for the coal-fired station. EGC believes that these impacts would be small due to the mitigating influence of the site's proximity to the Quad Cities population area. Cultural resource impacts would be unlikely, due to the previously disturbed nature of the site, and could be minimized by survey and recovery techniques (if needed).

Impacts to aquatic resources and water quality would be minimized due to the plant's use of the existing cooling water system. The new stacks, boilers, and rail deliveries would be an incremental addition to the visual impact from existing QCNPS structures and operations. Coal delivery would add noise and transportation impacts associated with unit-train traffic.

EGC believes that other construction and operation impacts would be small. In most cases, the impacts would be detectable, but they would not destabilize any important attribute of the resource involved. Due to the minor nature of these impacts,

mitigation would not be warranted beyond that mentioned.

Design Alternatives

The QCNPS site location lends itself to coal delivery by barge, a common practice along the Mississippi River waterway. This design alternative would necessitate construction of a barge offloading facility on Pool 14 and a conveyor system to the Station coal yard. These new facilities would result in greater construction impacts than upgrading the existing rail line. The alternative would trade barge traffic impacts for rail traffic impacts, a tradeoff that provides no obvious environmental benefit.

Use of cooling towers could reduce QCNPS cooling water intake and discharge by 90 percent. This would reduce impingement, entrainment, and thermal impacts, increase consumptive water use through evaporation, and introduce a visual impact (100-foot-high mechanical towers or 600-foot-high natural draft towers). These would be incremental changes to what are currently small impacts.

7.2.2.2 Gas-Fired Generation

NRC evaluated environmental impacts from gas-fired generation alternatives in the GEIS, focusing on combined-cycle plants. Section 7.2.1.4 presents EGC's reasons for defining the gas-fired generation alternative as a combined-cycle plant on the QCNPS site. Land-use impacts from gas-fired units on the site would be less than those of the coal-fired alternative. Reduced land requirements, due to construction on the existing site and a smaller facility footprint, would reduce impacts to ecological, aesthetic, and cultural resources as well. As discussed under "Other Impacts," a smaller workforce could have adverse socioeconomic impacts. Human health effects associated with air emissions would be of concern. Loss of aquatic biota due to cooling water withdrawals would be offset by the concurrent shutdown of the nuclear generators.

The coal-fired alternative defined by EGC in Section 7.2.1.1 would be located at QCNPS.

Air Quality

Natural gas is a relatively clean-burning fossil fuel. Also, because the heat recovery steam generator does not receive supplemental fuel, the combined-cycle operation is highly efficient (56 percent vs. 33 percent for the coal-fired alternative). Therefore, the gas-fired alternative would release similar types of emissions, but in lesser quantities than the coal-fired alternative. Control technology for gas-fired turbines focuses on NO_x emissions. EGC estimates the gas-fired alternative emissions to be as follows:

- SO_x = 133 tons per year
- NO_x = 426 tons per year
- CO = 88 tons per year
- PM = 74 tons per year (all particulates are PM_{10})

Table 7-5 shows how EGC calculated these emissions.

The Section 7.2.2.1 discussion of regional air quality, Clean Air Act requirements, and the NO_x State Implementation Plan Call is also applicable to the gas-fired generation alternative. NO_x effects on ozone levels, SO_x allowances, and NO_x emission offsets could all be issues of concern for gas-fired combustion. While gas-fired turbine emissions are less than coal-fired boiler emissions, and regulatory requirements are less stringent, the emissions are still substantial. EGC concludes that emissions from a gas-fired alternative located at QCNPS would noticeably alter local air quality, but would not destabilize regional resources. Air quality impacts would

therefore be moderate, but substantially smaller than those of coal-fired generation.

Waste Management

Gas-fired generation would result in almost no waste generation, producing minor (if any) impacts. EGC concludes that gas-fired generation waste management impacts would be small.

Other Impacts

Similar to the coal-fired alternative, the ability to construct the gas-fired alternative on the existing QCNPS site would reduce construction-related impacts.

To the extent practicable, EGC would route the pipeline along previously disturbed rights-of-way to minimize impacts. However, this would still be a costly (i.e., approximately $1 million/mile) and potentially controversial action with ecological impacts from installation of a minimum of six miles of buried 16-inch gas pipeline to QCNPS. The pipeline would require an additional 100 - 120 acres for an easement. EGC would mitigate the political impacts through public hearings and apply best management practices during construction, such as minimizing soil loss and restoring vegetation immediately after the excavation is backfilled. Construction would result in the loss of some less mobile animals (e.g., frogs and turtles). Because these animals are common throughout the area, EGC expects negligible reduction in their population as a result of construction. EGC does not expect that installation of a pipeline would create a long-term reduction in the local or regional diversity of plants and animals.

NRC estimated in the GEIS that 110 acres would be needed for a plant site; this much previously disturbed acreage is available at QCNPS, reducing loss of terrestrial habitat. Aesthetic impacts, erosion and sedimentation, fugitive dust, and construction debris impacts would be similar to the coal-fired alternative, but smaller because of the reduced site size. Socioeconomic impacts of construction would be minimal. Socioeconomic impacts would result from the decrease in operational workforce from approximately 850 employees at QCNPS. The GEIS estimates a work force of 150 for gas operations. EGC expects this number to be closer to 25 - 40 workers for a plant this size. EGC believes that these impacts would be small due to the mitigating influence of the site's proximity to the Quad Cities population area.

Use of cooling towers could reduce QCNPS cooling water intake and discharge by 90 percent. This would reduce impingement, entrainment, and thermal impacts, increase consumptive water use through evaporation, and introduce a visual impact (100-foot-high mechanical towers or 600-foot-high natural draft towers). These would be incremental changes to what are currently small impacts.

7.2.2.3 Purchased Power

As discussed in Section 7.2.1.5, EGC assumes that the generating technology used under the purchased power alternative would be one of those that NRC analyzed in the GEIS. EGC is also adopting by reference the NRC analysis of the environmental impacts from those technologies. Under the purchased power alternative, environmental impacts would still occur, but would be located elsewhere within the State. EGC believes that out-of-state imports would not be required.

The purchased power alternative would include constructing up to 200 miles of high-voltage (e.g., 500-kV) transmission lines to get power from the remote locations in Illinois to the EGC network. EGC believes most of the transmission lines could be routed along existing rights-of-way and assumes that the environmental impacts of transmission line construction would be moderate. As indicated in the introduction to Section 7.2.1.4, the environmental impacts of construction and operation of

new coal- or gas-fired generating capacity for purchased power at a previously undisturbed greenfield site would exceed those of a coal- or gas-fired alternative located on the QCNPS site.

Table 7-1. Coal-Fired Alternative.

Characteristic	Basis
Unit size = 550 MWe ISO rating net[a]	Set to match capacity of gas-fired alternative
Unit size = 583 MWe ISO rating gross[a]	Calculated based on 6 percent onsite power
Number of units = 3	Calculated to be ≤ QCNPS net capacity of 1,824 MWe
Boiler type = tangentially fired, dry-bottom	Minimizes nitrogen oxides emissions (EPA 1998, Table 1.1-3, pg 1.1-17)
Fuel type = bituminous, pulverized coal	Typical for coal used in Illinois
Fuel heating value = 9,648 Btu/lb	1999 value for coal used in Illinois (EIA 2000, Table 28)
Fuel ash content by weight = 6.9 percent	1999 value for coal used in Illinois (EIA 2000, Table 28)
Fuel sulfur content by weight = S = 1.01 percent	1999 value for coal used in Illinois (EIA 2000, Table 28)
Uncontrolled NO_X emission = 10 lb/ton Uncontrolled CO emission = 0.5 lb/ton Uncontrolled SO_x emission = 38 lb/ton × S	Typical for pulverized coal, tangentially fired, dry-bottom, New Source Performance Standard (EPA 1998, Table 1.1-3, pg 1.1-17)
Uncontrolled PM = 10 lb/ton Uncontrolled PM_{10} = 2.3 lb/ton	Typical for pulverized coal, tangentially fired, dry-bottom (EPA 1998, Table 1.1-4, pg 1.1-21)
Heat rate = 10,200 Btu/kWh	Typical for coal-fired single-cycle steam turbines (EIA 2000, pg 108)
Capacity factor = 0.85	Typical for large coal-fired units (EGC experience)
NO_X control = low NO_X burners, overfire air and selective catalytic reduction (95 percent reduction)	Best available and widely demonstrated for minimizing NO_x emissions (EPA 1998, Table 1.1-2).
Particulate control = fabric filters (baghouse-99.9 percent removal efficiency)	Best available for minimizing particulate emissions (EPA 1998, pp. 1.1-6 and -7)
SO_x control = Wet scrubber –lime (95 percent removal efficiency)	Best available for minimizing SO_x emissions (EPA 1998, Table 1.1-1, pg 1.1-13)

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

Btu	=	British thermal unit
CO	=	carbon monoxide
ISO rating	=	International Standards Organization rating at standard atmospheric conditions of 59°F, 60 percent relative humidity, and 14.696 pounds of atmospheric pressure per square inch
kWh	=	kilowatt hour
lb	=	pound
MW	=	megawatt
NO_x	=	nitrogen oxides
PM	=	particulate matter
PM_{10}	=	particulate matter nominally less than 10 microns diameter
S	=	sulfur
SO_x	=	sulfur oxides

Table 7-2. Gas-Fired Alternative.

Characteristic	Basis
Unit size = 550 MWe ISO rating net:[a] Two 184-MWe combustion turbines and a 182-MW_e heat recovery boiler	Manufacturer's standard size gas-fired combined cycle plant
Unit size = 572-MWe ISO rating gross:[a] Two 191.4-MWe combustion turbines 189.3-MWe heat recovery boiler	Calculated based on 4 percent onsite power
Number of units = 3	Provides 1,650 MWe ≤ DNPS Units 2 & 3 net capacity – 1,824 MWe
Heat rate = 6,120 Btu/kWh	Manufacturer's listed heat rate for General Electric Frame 7FA unit.
Fuel type = natural gas	Assumed
Fuel heating value = 1,021 Btu/ft^3	1999 value for natural gas used in Illinois (EIA 2000, Table 28)
NO_x emission = 0.0109 lb/MMBtu	Typical for large SCR-controlled gas fired units with water/steam injection (EPA 2000b)
CO emission = 0.00226 lb/MMBtu	Typical for large SCR-controlled gas fired units with water/steam injection (EPA 2000b)
Uncontrolled SO_x emission = 0.0034 lb/ton	Typical for gas-fired units (EPA 2000a, Table 3.1.2a)
Uncontrolled PM emission = 0.0066 lb/MMBtu	Typical for gas-fired units (EPA 2000a, Table 3.1.2a)
Uncontrolled PM_{10} emission = 0.0066 lb/MMBtu	Typical for gas-fired units (EPA 2000a, Table 3.1.2a)
Capacity factor = 0.85	Typical for large gas-fired base load units
NO_x control = selective catalytic reduction (SCR) with steam/water injection (90 percent reduction)	Best available for minimizing NO_X emissions (EIA 2000, Section 3.1.4.3)

a = The difference between "net" and "gross" is electricity consumed onsite.
Btu = British thermal unit
ft^3 = cubic foot
ISO rating = International Standards Organization rating at standard atmospheric conditions of 59°F, 60 percent relative humidity, and 14.696 pounds of atmospheric pressure per square inch
kWh = kilowatt hour
MM = million
MWe = megawatt - electric
NO_x = nitrogen oxides
PM = particulate matter
PM_{10} = particulate matter nominally less than 10 microns diameter
SO_x = sulfur oxides

Table 7-3. Air Emissions from Coal-Fired Alternative.

Parameter	Calculation	Result
Annual coal consumption	$3\text{ units} \times \frac{583\text{ MW}}{\text{unit}} \times \frac{10{,}200\text{ Btu}}{\text{kW} \times \text{hr}} \times \frac{1{,}000\text{ kW}}{\text{MW}} \times \frac{\text{lb}}{9.648\text{ Btu}} \times \frac{\text{ton}}{2{,}000\text{ lb}} \times 0.85 \times \frac{24\text{ hr}}{\text{day}} \times \frac{365\text{ day}}{\text{yr}}$	6,884,077 tons of coal per year
SO_x[a,c]	$\frac{38 \times 1.01\text{ lb}}{\text{ton}} \times \frac{\text{ton}}{2{,}000\text{ lb}} \times (1 - 95/100) \times \frac{6{,}884{,}077\text{ tons}}{\text{yr}}$	6,605 tons SO_x per year
NO_x[b,c]	$\frac{10\text{ lb}}{\text{ton}} \times \frac{\text{ton}}{2{,}000\text{ lb}} \times (1 - 95/100) \times \frac{6{,}884{,}077\text{ tons}}{\text{yr}}$	1,721 tons NO_x per year
CO[c]	$\frac{0.5\text{ lb}}{\text{ton}} \times \frac{\text{ton}}{2{,}000\text{ lb}} \times \frac{6{,}884{,}077\text{ tons}}{\text{yr}}$	1,721 tons CO per year
PM[d]	$\frac{10 \times 6.9\text{ lb}}{\text{ton}} \times \frac{\text{ton}}{2{,}000\text{ lb}} \times (1 - 99.9/100) \times \frac{6{,}884{,}077\text{ tons}}{\text{yr}}$	238 tons PM per year
PM_{10}[d]	$\frac{2.3 \times 6.9\text{ lb}}{\text{ton}} \times \frac{\text{ton}}{2{,}000\text{ lb}} \times (1 - 99.9/100) \times \frac{6{,}884{,}077\text{ tons}}{\text{yr}}$	55 tons PM_{10} per year

a. EPA 1998, Table 1.1-1.
b. EPA 1998, Table 1.1-2
c EPA 1998, Table 1.1-3
d. EPA 1998, Table 1.1-4.
CO = carbon monoxide
NO_x = oxides of nitrogen
PM = particulate matter
PM_{10} = particulates having diameter nominally less than 10 microns
SO_x = oxides of sulfur

Table 7-4. Solid Waste from Coal-Fired Alternative.

Parameter	Calculation	Result
Annual SO_x generated[a]	$\frac{6.884{,}077\ \text{ton coal}}{\text{yr}} \times \frac{1.01 \times 38\ \text{lb S}}{100\ \text{ton coal}} \times \frac{\text{ton}}{2000\ \text{lb}}$	132,105 tons of SO_x per year
Annual SO_x removed	$\frac{138{,}989\ \text{ton } SO_2}{\text{yr}} \times (95/100)$	125,500 tons of SO_x per year
Annual ash generated	$\frac{6{,}884{,}077\ \text{ton coal}}{\text{yr}} \times \frac{6.9\ \text{ton ash}}{100\ \text{ton coal}} \times (99.9/100)$	474,526 tons of ash per year
Annual lime consump-tion[b]	$\frac{132{,}105\ \text{ton } SO_2}{\text{yr}} \times \frac{56.1\ \text{ton CaO}}{64.1\ \text{ton } SO_2}$	115,618 tons of CaO per year
Calcium sulfate[c]	$\frac{125{,}500\ \text{ton } SO_2}{\text{yr}} \times \frac{172\ \text{ton } CaSO_4 \bullet 2H_2O}{64.1\ \text{ton } SO_2}$	337,088 tons of $CaSO_4 \bullet 2H_2O$ per year
Annual scrubber waste[d]	$\frac{1151{,}618\ \text{ton CaO}}{\text{yr}} \times \frac{(100-95)}{100} + 337{,}088\ \text{ton } CaSO_4 \bullet 2H_2O$	342,869 tons of scrubber waste per year
Total volume of scrubber waste[e]	$\frac{342{,}869\ \text{ton}}{\text{yr}} \times 40\ \text{yr} \times \frac{2{,}000\ \text{lb}}{\text{ton}} \times \frac{\text{ft}^3}{144.8\ \text{lb}}$	189,472,402 ft^3 of scrubber waste
Total volume of ash disposed onsite[f,g]	$\frac{474{,}526\ \text{ton}}{\text{yr}} \times \frac{100-87}{100} \times 40\ \text{yr} \times \frac{2{,}000\ \text{lb}}{\text{ton}} \times \frac{\text{ft}^3}{100\ \text{lb}}$	49,350,737 ft^3 of ash
Total volume of solid waste disposed onsite	$189{,}472{,}402\ \text{ft}^3 + 49{,}350{,}737\ \text{ft}^3$	238,823,139 ft^3 of solid waste
Waste pile area (acres)	$\frac{238{,}823{,}139\ \text{ft}^3}{30\ \text{ft}} \times \frac{\text{acre}}{43{,}560\ \text{ft}^2}$	183 acres of solid waste
Waste pile area (ft × ft square)	$\sqrt{(238{,}823{,}139\ \text{ft}^3/30\text{ft})}$	2,821 feet by 2,821 feet of solid waste

a. Calculations assume 100 percent combustion of coal. Some sulfur remains in ash, resulting in overestimation of SO_x emissions.
b. Lime consumption is based on total SO_2 generated.
c. Calcium sulfate generation is based on total SO_2 removed.
d Total scrubber waste includes scrubbing media carryover.
e Density of $CaSO_4 \bullet 2H_2O$ is 144.8 lb/ft^3.
f. Density of coal bottom ash is 100 lb/ft^3 (FHA 2000).
g. Assumed 87 percent of ash is recycled.
S = sulfur
SO_2 = sulfur dioxide
CaO = calcium oxide (lime)
$CaSO_4 \bullet 2H_2O$ = calcium sulfate dihydrate

Table 7-5. Air Emissions from Gas-Fired Alternative.

Parameter	Calculation	Result
Annual gas consumption	$3\,\text{unit} \times \frac{572\,\text{MW}}{\text{unit}} \times \frac{6{,}120\,\text{Btu}}{\text{kW} \times \text{hr}} \times \frac{1{,}000\,\text{kW}}{\text{MW}} \times 0.85 \times \frac{\text{ft}^3}{1{,}021\,\text{Btu}} \times \frac{24\,\text{hr}}{\text{day}} \times \frac{365\,\text{day}}{\text{yr}}$	76,588,928,815 ft^3 per year
Annual Btu input	$\frac{76{,}588{,}928{,}815\,\text{ft}^3}{\text{yr}} \times \frac{1{,}021\,\text{Btu}}{\text{ft}^3} \times \frac{\text{MM Btu}}{10^6\,\text{Btu}}$	78,197,296 MMBtu per year
SO_x[a]	$\frac{0.0034\,\text{lb}}{\text{MM Btu}} \times \frac{\text{ton}}{2{,}000\,\text{lb}} \times \frac{78{,}197{,}296\,\text{MMBtu}}{\text{yr}}$	133 tons SO_x per year
NO_x[b]	$\frac{0.0109\,\text{lb}}{\text{MM Btu}} \times \frac{\text{ton}}{2{,}000\,\text{lb}} \times \frac{78{,}197{,}296\,\text{MMBtu}}{\text{yr}}$	426 tons NO_x per year
CO[b]	$\frac{0.0023\,\text{lb}}{\text{MMBtu}} \times \frac{\text{ton}}{2{,}000\,\text{lb}} \times \frac{78{,}197{,}296\,\text{MMBtu}}{\text{yr}}$	88 tons CO per year
PM[a]	$\frac{0.0019\,\text{lb}}{\text{MMBtu}} \times \frac{\text{ton}}{2{,}000\,\text{lb}} \times \frac{78{,}197{,}296\,\text{MMBtu}}{\text{yr}}$	74 tons filterable PM per year
PM_{10}[a]	$\frac{74\,\text{tons TSP}}{\text{yr}}$	74 tons filterable PM_{10} per year

a EPA 2000a, Table 3 1-2a
b EPA 2000b
Btu = British thermal units
CO = carbon monoxide
MM = million
NO_x = oxides of nitrogen
PM_{10} = particulates having diameter less than 10 microns
SO_2 = sulfur dioxide
TSP = total suspended particulates

7.3 References

Note to reader: Some web pages cited in this document are no longer available, or are no longer available through the original URL addresses. Hard copies of all cited web pages are available in EGC files. Some sites, for example the census data, cannot be accessed through their URLs. The only way to access these pages is to follow queries on previous web pages. The complete URLs used by EGC have been given for these pages, even though they may not be directly accessible.

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Chapter 8

Comparison of Environmental Impacts of License Renewal with the Alternatives

NRC

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

8.1 Discussion

Chapter 4 analyzes environmental impacts of QCNPS license renewal and Chapter 7 analyzes impacts from alternatives to license renewal. Accordingly, Table 8-1 summarizes environmental impacts of the proposed action (license renewal) and the alternatives, so the reader can compare them. The environmental impacts compared in Table 8-1 are those that are either Category 2 issues for the proposed action, license renewal, or are issues that the *Generic Environmental Impact Statement* (GEIS) (NRC 1996) identifies as major considerations in an alternatives analysis. For example, although NRC concluded that air quality impacts from the proposed action would be small (Category 1), the GEIS identifies major human health concerns associated with air emissions from alternatives (Section 7.2.2). Therefore, Table 8-1 compares air impacts among the proposed action and the alternatives. Table 8-2 is a more detailed comparison of the alternatives.

Table 8-1. Impacts Comparison Summary.

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

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

Table 8-2. Impacts Comparison Detail.

Proposed Action (License Renewal)	Base (Decommissioning)	No-Action Alternative		
		With Coal-Fired Generation	With Gas-Fired Generation	With Purchased Power
		Alternative Descriptions		
QCNPS license renewal for 20 years, followed by decommissioning	Decommissioning following expiration of current QCNPS license. Adopting the GEIS description by reference (NRC 1996, Section 7.1) as comparable to QCNPS decommissioning.	New construction at the QCNPS site	New construction at the QCNPS site.	Would involve construction of new generation capacity in the state Adopting by reference GEIS description of alternate technologies (Section 7.2.1.5)
		Use existing switchyard and transmission lines.	Use existing switchyard and transmission lines.	
		Upgrade existing rail spur.	Construct 6 miles of gas pipeline along existing rights-of-way.	Construct up to 200 miles of transmission lines.
		Three 550-MW tangentially-fired, dry bottom units; capacity factor 0 85	Three 550-MW units, each consisting of two 184-MW combustion turbines and a 182-MW heat recovery boiler, capacity factor 0 85	
		Existing QCNPS cooling water system with potential construction of new cooling towers	Existing QCNPS cooling water system with potential construction of new cooling towers.	
		Pulverized bituminous coal, 9,648 Btu/pound; 10,200 Btu/kWh; 6.9% ash; 1.01% sulfur; 9 7 pound/ton nitrogen oxides; 6,884,077 tons coal/yr	Natural gas, 1,021 Btu/ft^3; 6,120 Btu/kWh; 0.0034 lb sulfur/MMBtu; 0.0109 lb NO_x/MMBtu; 75,588,928,815 ft^3 gas/yr	
		Low NO_x burners, overfire air, and selective catalytic reduction (95% NO_x reduction efficiency).	Selective catalytic reduction with steam/water injection	

Table 8-2 Impacts Comparison Detail (Continued).

Proposed Action (License Renewal)	Base (Decommissioning)	No-Action Alternative		
		With Coal-Fired Generation	With Gas-Fired Generation	With Purchased Power
		Wet scrubber – lime desulfurization system (95% SO_x removal efficiency), 122,000 tons limestone/yr Fabric filters (99.9% particulate removal efficiency)		
854 workers		250 workers (Section 7.2 2.1)	25-40 workers (Section 7 2.2.2)	
Land Use Impacts				
SMALL – Adopting by reference Category 1 issue findings (Table 4-2, Issues 52, 53)	SMALL – Not an impact evaluated by GEIS (NRC 1996)	SMALL – Construction at QCNPS would be in previously disturbed areas. The plant would upgrade existing rail spur and use transportation corridors Twenty years of ash and scrubber waste disposal would require 95 acres and construction of the power block and coal storage areas would impact approximately 300 acres. (Section 7 2 2.1)	SMALL – 110 acres for facility at QCNPS location; pipeline could be routed along existing rights-of-way and would require an additional 100-120 acres for easement (Section 7.2 2 2)	MODERATE – Most transmission facilities could be constructed along existing transmission corridors (Section 7 2 2 3) Adopting by reference GEIS description of land use impacts from alternate technologies (NRC 1996)

Table 8-2 Impacts Comparison Detail (Continued).

Proposed Action (License Renewal)	Base (Decommissioning)	No-Action Alternative		
		With Coal-Fired Generation	With Gas-Fired Generation	With Purchased Power
Water Quality Impacts				
SMALL – Adopting by reference Category 1 issue findings (Table 4-2, Issues 3, 6-12). Groundwater withdrawal has not impacted offsite wells (Section 4 5, Issue 33).	SMALL – Adopting by reference Category 1 issue finding (Table 4-2, Issue 89).	SMALL – Construction impacts minimized by use of best management practices. Operational impacts minimized by use of existing cooling water system. (Section 7.2.2.1).	SMALL – Reduced cooling water demands, inherent in combined-cycle design (Section 7 2 2 2) Construction of pipeline could cause temporary erosion and sedimentation in streams crossed by right-of-way (Section 7 2 2 2)	SMALL to MODERATE – Adopting by reference GEIS description of water quality impacts from alternate technologies (NRC 1996)
Air Quality Impacts				
SMALL – Adopting by reference Category 1 issue finding (Table 4-2, Issue 51).	SMALL – Adopting by reference Category 1 issue findings (Table 4-2, Issue 88)	MODERATE – 6,605 tons SO_x/yr 1,669 tons NO_x/yr 1,721 tons CO/yr 238 tons PM/yr 55 tons PM_{10}/yr (Section 7 2 2 1)	MODERATE – 133 tons SO_x/yr 426 tons NO_x/yr 88 tons CO/yr 74 tons PM_{10}/yr[a] (Section 7.2 2 2)	MODERATE – Adopting by reference GEIS description of air quality impacts from alternate technologies (NRC 1996)

Table 8-2 Impacts Comparison Detail (Continued).

Proposed Action (License Renewal)	Base (Decommissioning)	No-Action Alternative		
		With Coal-Fired Generation	With Gas-Fired Generation	With Purchased Power
Ecological Resource Impacts				
SMALL – Adopting by reference Category 1 issue findings (Table 4-2, Issues 15-24, 45-48). QCNPS holds a current NPDES permit, which constitutes compliance with Clean Water Act Section 316(b) (Section 4.2, Issue 25; Section 4.3, Issue 26) and 316(a) (Section 4 4, Issue 27)	SMALL – Adopting by reference Category 1 issue finding (Table 4-2, Issue 90)	SMALL – Construction of the power block and coal storage areas and 20 years of ash/sludge disposal would impact approximately 300 acres of terrestrial habitat, displacing various species. (Section 7.2 2 1) Potential new cooling towers would reduce impingement, entrainment, and thermal impacts to aquatic species	SMALL – Construction of power block and pipeline would impact up to 23 acres of terrestrial habitat, displacing various species. (Section 7 2 2 2) Potential new cooling towers would reduce impingement, entrainment, and thermal impacts to aquatic species	SMALL to MODERATE – Adopting by reference GEIS description of ecological resource impacts from alternate technologies (NRC 1996)
Threatened or Endangered Species Impacts				
SMALL – No resident threatened or endangered species are known to occur at the site or along transmission corridors (Section 4.10, Issue 49).	SMALL – Not an impact evaluated by GEIS (NRC 1996)	SMALL – Construction would occur at the QCNPS site, which has no resident threatened or endangered species.	SMALL – Construction would occur at the QCNPS site, which has no resident threatened or endangered species.	SMALL – Federal and state laws prohibit destroying or adversely affecting protected species and their habitats

Table 8-2 Impacts Comparison Detail (Continued).

Proposed Action (License Renewal)	Base (Decommissioning)	No-Action Alternative		
		With Coal-Fired Generation	With Gas-Fired Generation	With Purchased Power
Human Health Impacts				
SMALL – Adopting by reference Category 1 issues (Table 4-2, Issues 58, 61, 62) Risk from microbiological organisms minimal due to thermal characteristics at the discharge and lack of innoculant (Section 4.12, Issue 57). Risk due to transmission-line induced currents is slightly higher than provided by industry standards (Section 4.13, Issue 59)	SMALL – Adopting by reference Category 1 issue finding (Table 4-2, Issue 86)	MODERATE – Adopting by reference GEIS conclusion that risks such as cancer and emphysema from emissions are likely (NRC 1996)	SMALL – Adopting by reference GEIS conclusion that some risk of cancer and emphysema exists from emissions (NRC 1996)	SMALL to MODERATE – Adopting by reference GEIS description of human health impacts from alternate technologies (NRC 1996)
Socioeconomic Impacts				
SMALL – Adopting by reference Category 1 issue findings (Table 4-2, Issues 64, 67). Location in medium population area without growth controls minimizes potential for housing impacts (Section 4.14, Issue 63). Plant contribution to county tax base is significant, and continued plant operation would benefit county (Section 4.17.2, Issue 69). Capacity of public water supply and transportation infrastructure minimizes potential for related impacts (Section 4.15, Issue 65 and Section 4 18, Issue 70)	SMALL – Adopting by reference Category 1 issue finding (Table 4-2, Issue 91)	SMALL – Reduction in permanent work force at QCNPS to 250 workers could adversely affect surrounding counties, but would be mitigated by site's proximity to the Quad Cities (Section 7 2.2.1).	SMALL – Reduction in permanent work force at QCNPS to 25-40 workers could adversely affect surrounding counties, but would be mitigated by the site's proximity to the Quad Cities (Section 7.2 2 2)	SMALL to MODERATE – Adopting by reference GEIS description of socioeconomic impacts from alternate technologies (NRC 1996)

Table 8-2 Impacts Comparison Detail (Continued).

Proposed Action (License Renewal)	Base (Decommissioning)	No-Action Alternative		
		With Coal-Fired Generation	With Gas-Fired Generation	With Purchased Power
Waste Management Impacts				
SMALL – Adopting by reference Category 1 issue findings (Table 4-2, Issues 77-85)	SMALL – Adopting by reference Category 1 issue finding (Table 4-2, Issue 87)	MODERATE – 62,000 tons of coal ash per year and 361,000 tons of scrubber sludge per year would require 95 acres over the 20-year license renewal term. (Section 7 2 2.1)	SMALL – Almost no waste generation (Section 7.2 2 2)	SMALL to MODERATE – Adopting by reference GEIS description of waste management impacts from alternate technologies (NRC 1996)
Aesthetic Impacts				
SMALL – Adopting by reference Category 1 issue findings (Table 4-2, Issues 73, 74)	SMALL – Not an impact evaluated by GEIS (NRC 1996)	SMALL – Visual impacts would be consistent with the industrial nature of the site (Section 7 2 2.1)	SMALL – Visual impacts would be consistent with the industrial nature of the site (Section 7 2 2.2).	SMALL to MODERATE – Adopting by reference GEIS description of aesthetic impacts from alternate technologies (NRC 1996)
Cultural Resource Impacts				
SMALL – SHPO consultation minimizes potential for impact (Section 4.19, Issue 71)	SMALL – Not an impact evaluated by GEIS (NRC 1996)	SMALL – Impacts to cultural resources would be unlikely due to developed nature of the site (Section 7.2 2 1)	SMALL – Impacts would be small due to developed nature of the site and use of existing pipeline/transmission right-of-way (Section 7 2.2 2)	SMALL – Adopting by reference GEIS description of cultural resource impacts from alternate technologies (NRC 1996)

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

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

Btu = British thermal unit
ft^3 = cubic foot
gal = gallon
GEIS = Generic Environmental Impact Statement (NRC 1996)
kWh = kilowatt-hour
lb = pound
MM = million
MW = megawatt
NO_x = oxides of nitrogen
PM_{10} = particulates having diameter less than 10 microns
SHPO = State Historic Preservation Officer
SO_x = sulfur oxides
TSP = total suspended particulates
yr = year

8.2 References

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

Chapter 9

Status of Compliance

9.1 Proposed Action

NRC

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

9.1.1 GENERAL

Table 9-1 lists environmental authorizations that EGC has obtained for current QCNPS operations. In this context, EGC uses "authorizations" to include any permits, licenses, approvals, or other entitlements. EGC will continue to renew these authorizations during the current license period and through the NRC license renewal period. Based on the new and significant information identification process described in Chapter 5, Exelon concludes that QCNPS Units 1 and 2 are in compliance with applicable environmental standards and requirements.

Table 9-2 lists additional environmental authorizations and consultations related to NRC renewal of the QCNPS licenses to operate. As indicated, EGC anticipates needing relatively few such authorizations and consultations. Sections 9.1.2 through 9.1.5 discuss some of these items in more detail.

9.1.2 THREATENED OR ENDANGERED SPECIES

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

Although not required of an applicant by federal law or NRC regulation, EGC invited comment from federal and state agencies regarding potential effects that QCNPS license renewal might have. Appendix C includes copies of EGC correspondence with FWS, the Illinois Department of Natural Resources, and the Iowa Department of Natural Resources. EGC did not consult with NMFS because species under the auspices of NMFS are not known to be in the QCNPS vicinity.

Based on the EGC submittals and other information, as discussed in detail in Section 4.10, the agencies concur with the EGC conclusion that QCNPS license renewal would not adversely affect threatened or endangered species or critical

habitat. The Illinois Department of Natural Resources elected to keep the consultation open in case improvements to the transmission lines become necessary

9.1.3 COASTAL ZONE MANAGEMENT PROGRAM COMPLIANCE

The Federal Coastal Zone Management Act (16 USC 1451 et seq.) imposes requirements on applicants for a federal license to conduct an activity that could affect a state's coastal zone (NRC 2001). The Act requires the applicant to certify to the licensing agency that the proposed activity would be consistent with the state's federally approved coastal zone management program [16 USC 1456(c)(3)(A)]. The National Oceanic and Atmospheric Administration has promulgated implementing regulations that indicate that the requirement is applicable to renewal of federal licenses for activities not previously reviewed by the state [15 CFR 930.51(b)(1)]. The regulation requires that the license applicant provide its certification to the federal licensing agency and a copy to the applicable state agency [15 CFR 930.57(a)].

Participation in the National Oceanic and Atmospheric Administration Coastal Zone Management Program is voluntary; federal assistance is given to states willing to develop and implement a comprehensive coastal management program (DOE 1996). Illinois has opted to not participate in the program and therefore does not need to demonstrate compliance with the Coastal Zone Management Act (NOAA 2000). Because QCNPS is over 1,000 miles upstream from the Gulf of Mexico, EGC believes that QCNPS license renewal would affect no coastal resources and that the certification requirement is inapplicable to QCNPS license renewal.

9.1.4 HISTORIC PRESERVATION

Section 106 of the National Historic Preservation Act (16 USC 470 et seq.) requires federal agencies having the authority to license any undertaking to, prior to issuing the license, take into account the effect of the undertaking on historic properties and to afford the Advisory Committee on Historic Preservation an opportunity to comment on the undertaking. Committee regulations provide for establishing an agreement with any State Historic Preservation Officer (SHPO) to substitute state review for Committee review (35 CFR 800.7). Although not required of an applicant by federal law or NRC regulation, EGC has chosen to invite comment by the Illinois and Iowa SHPOs. Appendix E includes copies of EGC correspondence with these SHPOs regarding potential effects that QCNPS license renewal might have on historic or cultural resources.

Based on the EGC submittal and other information, the Illinois and Iowa SHPOs concurred with EGC's conclusion that QCNPS license renewal would not affect known historic or archaeological properties.

9.1.5 WATER QUALITY (401) CERTIFICATION

Federal Clean Water Act Section 401 requires applicants for a federal license to conduct an activity that might result in a discharge into navigable waters to provide the licensing agency a certification from the state that the discharge will comply with applicable Clean Water Act requirements (33 USC 1341). NRC has indicated in its *Generic Environmental Impact Statement for License Renewal of Nuclear Power Plants* (GEIS) that issuance of a National Pollutant Discharge Elimination System (NPDES) permit implies certification by the

state (NRC 1996). EGC is applying to NRC for license renewal to continue QCNPS operations. Appendix B contains the QCNPS NPDES permit. Consistent with the GEIS, QCNPS is providing evidence of its NPDES permit as evidence of state water quality (401) certification.

9.2 Alternatives

NRC

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

The coal, gas, and purchased power alternatives discussed in Section 7.2.1 probably could be constructed and operated to comply with all applicable environmental quality standards and requirements. EGC notes that increasingly stringent air quality protection requirements could make the construction of a large fossil-fueled power plant infeasible in many locations. EGC also notes that the U.S. Environmental Protection Agency has revised requirements (EPA 2001) that could affect the design of cooling water intake structures for new facilities and has proposed requirements (EPA 2002) that would affect modifications at existing facilities. As drafted, the requirements may necessitate construction of cooling towers for the coal- and gas-fired alternatives.

Table 9-1. Environmental Authorizations for Current Operations.

Agency	Authority	Requirement	Number	Issue or Expiration Date	Activity Covered
U. S. Nuclear Regulatory Commission	Atomic Energy Act (42 USC 2011, et seq.), 10 CFR 50.10	License to operate	DPR – 29 - Unit 1 DPR – 30 - Unit 2	Issued 12/14/72 Expires 12/14/12	Operation of Units 1 and 2
U.S. Department of Transportation	49 USC 5108	Registration	052901005030JL	Issued 05/30/01 Expires 06/30/04	Hazardous materials shipments
Illinois Environmental Protection Agency	Clean Water Act (33 USC Section 1251 et seq.), Illinois Environmental Protection Act (Title 35 IAC, Subtitle C, Ch. 1)	NPDES permit	IL0005037	Issued 05/26/00 Expires 05/31/05	Plant discharges to the Mississippi River
Illinois Environmental Protection Agency	Federal Clean Air Act (42 USC 7661 et seq.), IRS Ch.111-1/2, Sec.1039	Federally enforceable state operating permit	161807AAB	Issued 12/11/00 Expires 12/11/05	Air emissions from boilers and generators
Illinois Environmental Protection Agency	IRS Ch.111-1/2 Sec.1039	Permit	2002-EA-5001	Issued 01/17/02 Expires 12/31/06	Dredge Material Sedimentation Pond
Illinois Environmental Protection Agency	35 IAC 391	Permit	1999-SC-3002-1	Issued 04/06/99 Expires 03/01/04	Land application of sewage treatment plant sludge
U.S. Army Corps of Engineers	Rivers & Harbors Act (33 USC 403); Clean Water Act (33 USC 1344)	Dredging permit	CENCR-0D-S-297290	Issued 04/14/95 Expires 12/31/04	Dredging near water intake
U.S. Environmental Protection Agency	Resource Conservation and Recovery Act (42 USC 6901 et seq.), 35 IAC 703	Part A permit	ID No. ILD060862810	Issued 12/19/00 Expiration not applicable	Storage of radioactive hazardous (i.e., mixed) waste

Table 9-1. Environmental Authorizations for Current Quad Cities Operations (Continued).

Agency	Authority	Requirement	Number	Issue or Expiration Date	Activity Covered
Illinois Environmental Protection Agency	IRS Ch.111-1/2, Sec.1039	Open burning permit	App. # B0112024 ID # 043083 Location ID# 161807AAB	Issued 01/17/02 Expires 02/16/03	Burning for fire fighter training
Illinois Department of Public Health	77 IAC 900	Registration	PW-0110833	Issued 01/07/02 Expires 12/31/02	Non-community water supply
Illinois Department of Nuclear Safety	32 IAC 609	Waste tracking permit	IL-0102	Not applicable	Shipments of low-level radioactive waste
South Carolina Department of Health and Environmental Control	South Carolina Radioactive Waste Transportation and Disposal Act (S.C. Code of Laws 13-7-110 et seq.)	Radioactive waste transport permit	0015-12-02-X	Issued 12/07/01 Expires 12/31/02	Transportation of radioactive waste in South Carolina
Tennessee Department of Environment and Conservation	Tennessee Code Annotated 68-202-206	License to ship radioactive material	T-IL-006-L00	Issued 01/01/01 Expires 12/31/02	Shipments of radioactive material to processing facility in Tennessee
Utah Department of Environmental Quality		Generator Site Access permit	0110000029	Issued 11/02/01 Expires 03/31/03	Shipments of radioactive waste to land disposal facility (Envirocare) in Utah

CFR - Code of Federal Regulations
USC - United States Code
IAC - Illinois Administrative Code
IRS - Illinois Revised Statutes
NPDES - National Pollutant Discharge Elimination System

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

Agency	Authority	Requirement	Remarks
U.S. Nuclear Regulatory Commission	Atomic Energy Act (42 USC 2011 et seq)	License renewal	Environmental Report submitted in support of license renewal application
U.S. Fish and Wildlife Service	Endangered Species Act, Section 7 (16 USC 1536)	Consultation	Requires federal agency issuing a license to consult with FWS (Appendix C)
Illinois Environmental Protection Agency	Clean Water Act, Section 401 (33 USC 1341)	Certification	Requires State certification that proposed action would comply with Clean Water Act standards
Illinois Historic Preservation Agency and the State Historical Society of Iowa	National Historic Preservation Act, Section 106 (16 USC 470f)	Consultation	Requires federal agency issuing a license to consider cultural impacts and consult with State Historic Preservation Officer (Appendix E)

a No renewal-related requirements identified for local or other agencies

9.3 References

Note to reader: Some web pages cited in this document are no longer available, or are no longer available through the original URL addresses. Hard copies of all cited web pages are available in EGC files. Some sites, for example the census data, cannot be accessed through their URLs. The only way to access these pages is to follow queries on previous web pages. The complete URLs used by EGC have been given for these pages, even though they may not be directly accessible.

DOE (U.S. Department of Energy), 1996. *OPEA Environmental Law Summary: Coastal Zone Management Act*, available at http://tis-nt.eh.doe.gov/oepa/law_sum/CZMA.htm, accessed March 12, 2001.

EPA (U.S. Environmental Protection Agency), 2001. "National Pollutant Discharge Elimination System: Regulations Addressing Cooling Water Intake Structures for New Facilities; Final Rule." *Federal Register*, Vol. 66, No. 243, December 18.

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NOAA (National Oceanic and Atmospheric Administration), 2000. *The Coastal Zone Management Program*, available at http://www.ocrm.nos.noaa.gov/czm/welcome.html, accessed March 15, 2001.

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

NRC (U.S. Nuclear Regulatory Commission), 2001. *Procedural Guidance for Preparing Environmental Assessments and Considering Environmental Issues*, NRR Office Instruction No. LIC-203, June 21.

Appendix A

NRC NEPA Issues for License Renewal of Nuclear Power Plants

Appendix F - Quad Cities Nuclear Power Station Environmental Report

EGC has prepared this environmental report in accordance with the requirements of NRC regulation 10 CFR 51.53. NRC included in the regulation a list of National Environmental Policy Act issues for license renewal of nuclear power plants. Table A-1 lists these 92 issues and identifies the section in which EGC addressed each issue in the environmental report. For expediency, EGC has assigned a number to each issue and uses the issue numbers throughout the environmental report.

Table A-1 Quad Cities Nuclear Power Station Environmental Report Cross-Reference of License Renewal NEPA Issues.[a]

	Issue	Category	Section of this Environmental Report
1.	Impacts of refurbishment on surface water quality	1	4.0
2.	Impacts of refurbishment on surface water use	1	4.0
3.	Altered current patterns at intake and discharge structures	1	4.0
4.	Altered salinity gradients	1	4.0
5.	Altered thermal stratification of lakes	1	4 0
6.	Temperature effects on sediment transport capacity	1	4.0
7.	Scouring caused by discharged cooling water	1	4.0
8.	Eutrophication	1	4.0
9.	Discharge of chlorine or other biocides	1	4.0
10.	Discharge of sanitary wastes and minor chemical spills	1	4 0
11.	Discharge of other metals in waste water	1	4.0
12.	Water use conflicts (plants with once-through cooling systems)	1	4.0
13.	Water use conflicts (plants with cooling ponds or cooling towers using make-up water from a small river with low flow)	2	4.1
14.	Refurbishment impacts to aquatic resources	1	4 0
15.	Accumulation of contaminants in sediments or biota	1	4.0
16.	Entrainment of phytoplankton and zooplankton	1	4.0
17.	Cold shock	1	4.0
18.	Thermal plume barrier to migrating fish	1	4.0
19.	Distribution of aquatic organisms	1	4.0
20.	Premature emergence of aquatic insects	1	4.0
21.	Gas supersaturation (gas bubble disease)	1	4.0
22.	Low dissolved oxygen in the discharge	1	4.0
23.	Losses from predation, parasitism, and disease among organisms exposed to sublethal stresses	1	4.0
24.	Stimulation of nuisance organisms (e.g., shipworms)	1	4.0
25.	Entrainment of fish and shellfish in early life stages for plants with once-through and cooling pond heat dissipation systems	2	4.2
26.	Impingement of fish and shellfish for plants with once-through and cooling pond heat dissipation systems	2	4.3
27.	Heat shock for plants with once-through and cooling pond heat dissipation systems	2	4.4
28.	Entrainment of fish and shellfish in early life stages for plants with cooling-tower-based heat dissipation systems	1	4.0

Table A-1. Quad Cities Nuclear Power Station Environmental Report Cross-Reference of License Renewal NEPA Issues[a] (Continued).

	Issue	Category	Section of this Environmental Report
29.	Impingement of fish and shellfish for plants with cooling-tower-based heat dissipation systems	1	4.0
30	Heat shock for plants with cooling-tower-based heat dissipation systems	1	4.0
31.	Impacts of refurbishment on groundwater use and quality	1	4.0
32.	Groundwater use conflicts (potable and service water, plants that use < 100 gpm)	1	4.0
33.	Groundwater use conflicts (potable, service water, and dewatering; plants that use > 100 gpm)	2	4.5
34.	Groundwater use conflicts (plants using cooling towers withdrawing make-up water from a small river)	2	4.6
35.	Groundwater use conflicts (Ranney wells)	2	4.7
36.	Groundwater quality degradation (Ranney wells)	1	4.0
37.	Groundwater quality degradation (saltwater intrusion)	1	4.0
38.	Groundwater quality degradation (cooling ponds in salt marshes)	1	4.0
39.	Groundwater quality degradation (cooling ponds at inland sites)	2	4.8
40.	Refurbishment impacts to terrestrial resources	2	4.9
41.	Cooling tower impacts on crops and ornamental vegetation	1	4.0
42.	Cooling tower impacts on native plants	1	4.0
43.	Bird collisions with cooling towers	1	4.0
44.	Cooling pond impacts on terrestrial resources	1	4.0
45.	Power line right-of-way management (cutting and herbicide application)	1	4.0
46.	Bird collisions with power lines	1	4.0
47.	Impacts of electromagnetic fields on flora and fauna (plants, agricultural crops, honeybees, wildlife, livestock)	1	4.0
48.	Floodplains and wetlands on power line right-of-way	1	4.0
49.	Threatened or endangered species	2	4.10
50.	Air quality during refurbishment (non-attainment and maintenance areas)	2	4.11
51.	Air quality effects of transmission lines	1	4.0
52.	Onsite land use	1	4 0
53	Power line right-of-way land use impacts	1	4.0
54.	Radiation exposures to the public during refurbishment	1	4.0
55.	Occupational radiation exposures during refurbishment	1	4.0
56.	Microbiological organisms (occupational health)	1	4.0

Table A-1 Quad Cities Nuclear Power Station Environmental Report Cross-Reference of License Renewal NEPA Issues.[a]

	Issue	Category	Section of this Environmental Report
57.	Microbiological organisms (public health) (plants using lakes or canals, or cooling towers or cooling ponds that discharge to a small river)	2	4.12
58.	Noise	1	4.0
59.	Electromagnetic Fields, Acute Effect (Electric Shock)	2	4.13
60.	Electromagnetic fields, chronic effects	NA[b]	4.0
61.	Radiation exposures to public (license renewal term)	1	4 0
62.	Occupational radiation exposures (license renewal term)	1	4.0
63.	Housing impacts	2	4.14
64.	Public services: public safety, social services, and tourism and recreation	1	4 0
65.	Public services: public utilities	2	4.15
66.	Public services: education (refurbishment)	2	4.16
67.	Public services: education (license renewal term)	1	4.0
68.	Offsite land use (refurbishment)	2	4.17.1
69.	Offsite land use (license renewal term)	2	4.17.2
70.	Public services: transportation	2	4 18
71.	Historic and archaeological resources	2	4.19
72.	Aesthetic impacts (refurbishment)	1	4.0
73.	Aesthetic impacts (license renewal term)	1	4.0
74.	Aesthetic impacts of transmission lines (license renewal term)	1	4.0
75.	Design basis accidents	1	4.0
76.	Severe accidents	2	4.20
77.	Offsite radiological impacts (individual effects from other than the disposal of spent fuel and high-level waste)	1	4 0
78.	Offsite radiological impacts (collective effects)	1	4.0
79.	Offsite radiological impacts (spent fuel and high-level waste disposal)	1	4.0
80.	Nonradiological impacts of the uranium fuel cycle	1	4.0
81.	Low-level waste storage and disposal	1	4.0
82.	Mixed waste storage and disposal	1	4.0
83.	Onsite spent fuel	1	4.0
84.	Nonradiological waste	1	4.0
85.	Transportation	1	4.0
86.	Radiation doses (decommissioning)	1	4.0
87.	Waste management (decommissioning)	1	4.0
88.	Air quality (decommissioning)	1	4.0
89.	Water quality (decommissioning)	1	4.0

Table A-1. Quad Cities Nuclear Power Station Environmental Report Cross-Reference of License Renewal NEPA Issues[a] (Continued).

	Issue	Category	Section of this Environmental Report
90	Ecological resources (decommissioning)	1	4.0
91.	Socioeconomic impacts (decommissioning)	1	4.0
92.	Environmental justice	NA[b]	2.6.2

a Source 10 CFR 51, Subpart A, Appendix A, Table B-1. (Issue numbers added to facilitate discussion)
b. Not applicable Regulation does not categorize this issue
NEPA = National Environmental Policy Act.