Revision 1

Supplement to

Environmental Report

Quad-Cities Nuclear Power Station

Extended Power Uprate

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1.0 INTRODUCTION

ComEd, an Exelon Company, is committed to environmentally responsible business practices. ComEd utilizes proactive management strategies, leading-edge technologies, and voluntary actions to protect its shared environment and to preserve natural resources. This environmental stewardship is demonstrated by ComEd's respect for public health and the environment, while providing safe, reliable, and economical service to its customers. ComEd relies upon a proactive environmental management organization that emphasizes alliances with surrounding communities and customers to conserve resources, promote renewable energy, restore habitat, and reduce pollution at its source (Ref. 1). In keeping with this commitment to environmental stewardship, ComEd has conducted a comprehensive environmental evaluation of the proposed Quad Cities Nuclear Power Station (QCNPS) Extended Power Uprate (EPU) from 2,511 megawatts thermal (MWt) to 2,957 MWt (i.e., 809 megawatts electrical [MWe] to 912 MWe) for both Unit 1 and Unit 2. The proposed uprate will service the future power requirements of the ComEd customer base, whose peak demand is estimated to increase by 28 percent from 2000 through 2014.

A prerequisite to the EPU at the QCNPS is the preparation of an Environmental Assessment Report to assist the U.S. Nuclear Regulatory Commission (NRC) in deciding upon issuance of operating license amendments for generating Units 1 and 2. 10 CFR 51.41, "Requirement to Submit Environmental Information," requires that applications to the NRC be in compliance with Section 102(2) of the National Environmental Policy Act (NEPA) and in accordance with the regulations for implementing the procedural provisions of NEPA (40 CFR 1500-1508). Environmental report general requirements are outlined in 10 CFR 51.45, "Environmental Report." There are no NRC regulatory requirements or guidance documents specific to environmental documentation for EPU applications. This report is intended to provide sufficient detail in this environmental assessment report regarding both radiological and non-radiological environmental impacts for the NRC to make an informed decision regarding the proposed action.

In September 1972, the U.S. Atomic Energy Commission (AEC), predecessor to the NRC, published the Final Environmental Statement (FES) on the operation of QCNPS Units 1 and 2. The AEC/NRC concluded that issuance of a full-term operating license for Units 1 and 2, subject to specified limitations for the protection of the environment, was the proper course of action under NEPA, based on the analysis presented in the FES and the weight of environmental, economic, technical, and other benefits of the Station, versus environmental costs and available alternatives. This environmental assessment report will address impacts of the EPU to the environment, compare changes to those presented in the FES or in more recent environmental reports, identify reasonable alternatives to the proposed EPU, and recommend the proper course of action.

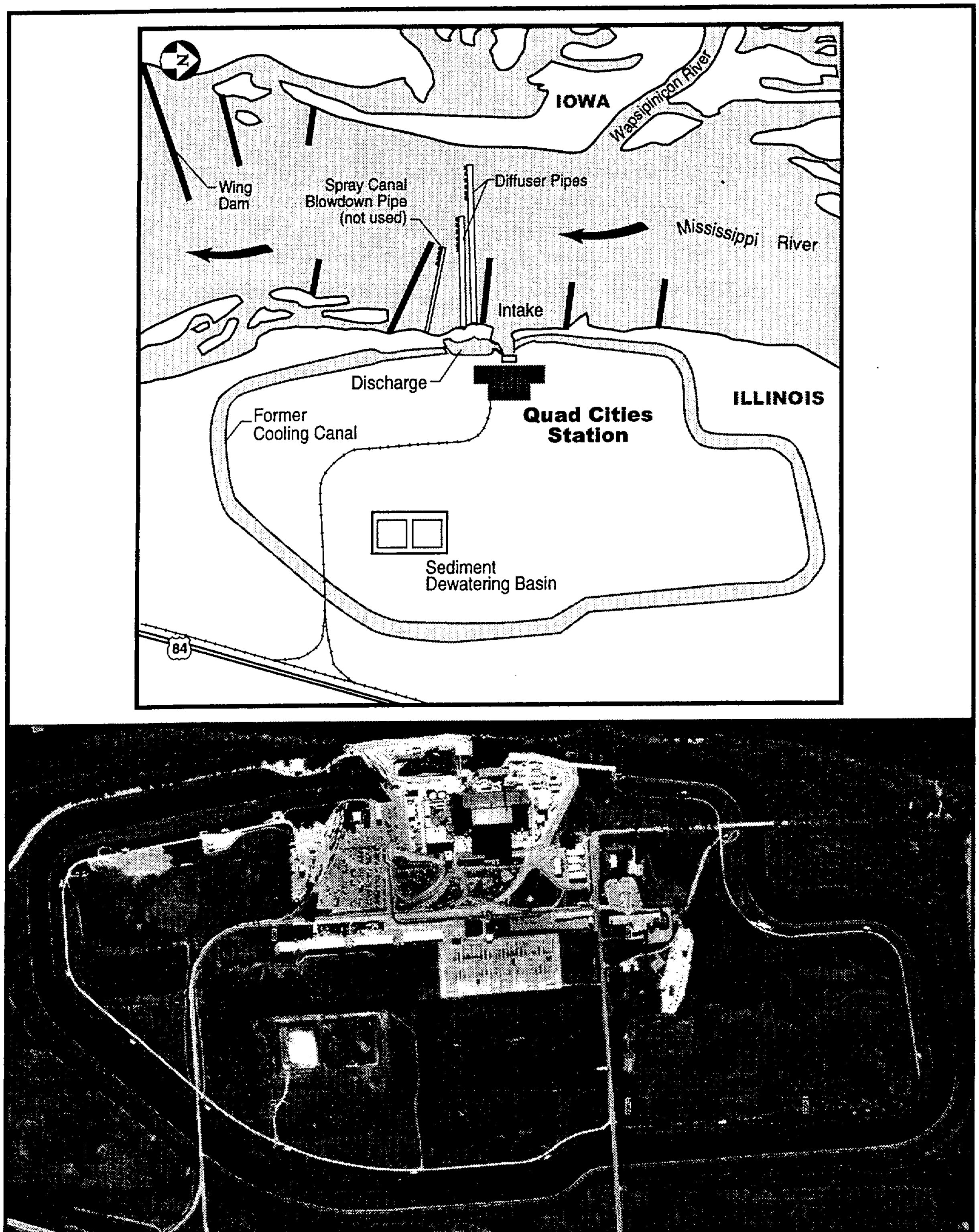
2.0 PROPOSED ACTION AND NEED

QCNPS is a nuclear-powered steam electric generating facility consisting of two boiling water reactors (BWR) operating in a direct thermodynamic cycle between the reactors and the turbines. EPU will increase the heat output of the reactors to support increased inlet steam flow to the turbines. To support an EPU from 2,511 MWt to 2,957 MWt, the reactor core operating range will be expanded by increasing reactor power, using a plant performance improvement program known as MELLL/ARTS (Maximum Extended Load Line Limit/APRM [Average Power Range Monitor], RBM [Rod Block Monitor], and Technical Specification changes). No changes in operating pressure or core flow are necessary to support EPU. Environmental impacts from these operational changes are discussed in Chapter 3.

ComEd operates the QCNPS on the east bank of the Mississippi River, about four miles north of Cordova, Illinois, and 20 miles northeast of the Quad-Cities area. The Quad Cities are Davenport, Iowa, and Rock Island, Moline, and East Moline, Illinois. The Station (Figure 2-1) is situated on approximately 560 acres of land owned by ComEd and contains the Station and an approximately three-mile-long spray cooling canal, now used for raising sport fish. The site is flat, with a grade level about nine feet above maximum flood stage (Ref. 2). Land use in the area is largely agricultural with industrial concentrations in Clinton, Iowa (seven miles to the northwest), and the Quad Cities area. The river is a source of municipal water and is also used for commercial and sport fishing, commercial navigation, and for recreational boating. The site was selected to service ComEd's western area, to help Cordova, Illinois, expand its industrial area to the north, and to utilize the Mississippi River for cooling water.

QCNPS Units 1 and 2 were granted construction permits on February 15, 1967. Low-power license DPR-29 for Unit 1 was issued on October 1, 1971 (Ref. 2). Low-power testing began in January 1972. On April 24, 1972, Operating License DPR-30 was issued for Unit 2 and license DPR-29 was amended to permit both units to operate at up to 20 percent power. Start-up testing was completed in August 1972 and the full-power license extends from December 14, 1972, until December 14, 2012, for both units (Ref. 3).

The licensing process included participation by the State of Illinois and citizen organizations concerned with effects of thermal effluent in the Mississippi River. ComEd entered into agreements with these stakeholders regarding the management of QCNPS discharges from the cooling water system. 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 (Ref. 3). This system was used for about eight months in 1972, after which a diffuser system was operated in the river. ComEd and the stakeholders agreed in 1972 that ComEd would install a closed-cycle system by 1975. The closed-cycle system



Utility/ComEd-Uprate/Grfx/F2-1 QCNPS pic.ai

Figure 2-1. A schematic description of the cooling water systems at QCNPS. The bottom graphic displays a 1994 aerial photograph of the station provided by the USGS through the Terra Server website (http://terraserver.microsoft.com).

included a spray canal with blow-down directed into a third diffuser pipe in the river. The spray canal was considerably less efficient than anticipated and, in 1979, revisions to the National Pollutant Discharge Elimination System (NPDES) permit and agreements with the stakeholders allowed partial open-cycle operation of the condenser cooling system.

Based on an extensive study of the diffuser system, it was determined that QCNPS could operate at full load in the open-cycle mode while still meeting NPDES permit limits under most river flow conditions (Ref. 4). To demonstrate compliance with permit limits at low river flows, the permit incorporates a temperature monitoring curve that allows QCNPS to calculate plant load as a function of river flow and ambient temperature, or measure the river temperatures at the downstream boundary of the mixing zone. When NPDES permit temperature limits are approached at the mixing zone boundary, the temperature monitoring curve provides a means to calculate permissible plant load as a function of river flows. Based on these data and no apparent detrimental impacts from thermal discharges to the river, the parties agreed in 1983 to allow open-cycle operation (Ref. 5). The temperature monitoring curve was modified in 1990, based on measurements taken during the drought years of 1988 and 1989 (Ref. 6).

Due to the design and safety margins built into plant equipment, the proposed EPU operational changes described above can be accomplished with relatively few plant modifications. The most significant changes will involve replacing the high-pressure turbines and installing a new condensate demineralizer vessel on both units. The modifications will be accomplished by normal maintenance and modification procedures, similar to those performed during normal outages. The majority of plant systems will not require any significant modification.

2.1 Description of Proposed Action

ComEd has established the goal of increasing electrical generating capacity in a cost-effective and environmentally sound manner. Therefore, ComEd and the Station designer, General Electric, have comprehensively evaluated the effects of EPU at the QCNPS Units 1 and 2. This evaluation concluded that safety and design margins are sufficient to allow an increase in the rated core thermal power from 2,511 MWt to 2,957 MWt without adversely impacting the safety of the public and without significantly impacting the environment. Therefore, the proposed action is to amend the operating licenses and supporting technical specifications for QCNPS Units 1 and 2 to allow for an increase in the licensed core thermal power level to 2,957 MWt.

2.2 Need for Proposed Action

ComEd forecasts a 28 percent increase in electrical demand by 2014 within its traditional Illinois service area. A plan has been prepared for the period from 2000 through 2014 to evaluate resource needs. Completion of EPU on the first generating unit will increase the ComEd generating capacity by approximately 0.76 percent. When EPU is completed on the second generating unit, another similar increase in system generating capacity is forecast. Uprating generating capacity at QCNPS is more economical for ComEd than constructing new generating capacity. Also see Section 4.0 for a detailed discussion of alternatives to the proposed action.

The ComEd service area is part of the Mid-America Interconnected Network (MAIN) North American Electric Reliability Council (NERC) region. The MAIN NERC has forecast adequate generating capacity of participating utilities over the next five years. However, in the coming deregulated marketplace, new market companies will also serve the traditional ComEd service area. To continue reliable, cost-effective service, ComEd must fulfill customer power demands, while also marketing power to other providers. In Illinois, other power providers have proposed and/or begun construction of approximately 40 gas turbine "peaker" plants of various sizes in anticipation of the increase in demand and the deregulated marketplace (Ref. 7). In this deregulated arena, the proposed EPU will displace approximately two 100 MWe gas turbines.

3.0 ENVIRONMENTAL IMPACTS

3.1 Socioeconomic Considerations

The proposed EPU does not significantly affect the size of the QCNPS work force and does not have a material effect on the labor force required for future plant outages. During 2000, QCNPS employed 854 full-time staff and 123 contract personnel for a total of 977 employees. Over 96 percent of the employees resided within six counties surrounding the Station. Because the Station is located on the border of Illinois and Iowa, approximately 65 percent of the work force resides in Illinois and 34 percent in Iowa. During 2000, the annual average ComEd employee salary was $65,704 and the average contractor's salary was $49,920. The average per capita income in Rock Island County (Illinois) during 1994 was $21,513 and the median household income was $31,242 (Ref. 8). Therefore, QCNPS workers have a disproportionate, but positive, influence on the economies of the region due to their higher incomes.

Material and labor costs for equipment required to implement the EPU at the QCNPS are approximately $19 million. Local taxing authorities will experience an increase in their property tax bases and significant positive economic benefits will be realized by local and national businesses participating in this proposed EPU. In addition, engineering and consulting firms, equipment suppliers, and service industries will receive payments for EPU activities. The direct revenue associated with EPU installation will not be sustained once modifications are complete. However, the economic benefits associated with the EPU will represent a positive impact on the regional economies, both in terms of the one-time benefit of EPU installation and in the long-term viability of operating QCNPS.

The assessed value of the QCNPS has increased since construction was completed. Table 3-1 presents the equalized assessed valuation of the station for 1990, 1995, and 1999. The assessed value has increased approximately $44 million over this time period, resulting in additional revenues for the local taxing authorities (Table 3-2). Communities surrounding QCNPS have benefited and will continue to benefit from local taxes paid by ComEd. Public services, including law enforcement, fire protection, public education, and health services, receive a significant amount of economic support through these tax revenues.

Table 3-1. Equalized Assessed Valuation for the Quad-Cities Nuclear Power Station for 1990, 1995, and 1999.

	1990	1995	1999
Equalized Assessed Value	$24,849,222	$60,088,241	$68,787,011

Table 3-2. Taxes Paid by Commonwealth Edison for the Quad-Cities Nuclear Power Station for Tax Years 1995 – 1999.

Tax Year	Property Tax Payment
1995	$2,999,605
1996	$3,000,467
1997	$3,209,541
1998	$3,360,576
1999	$3,489,290

The socioeconomic effects of implementing EPU at the QCNPS are, in part, dependent on the ability of ComEd to remain competitive in a market that is being deregulated. Implementation of EPU is not the primary factor affecting the overall competitiveness of ComEd, but it is a factor that must be considered. ComEd has determined that, notwithstanding the uncertainty associated with deregulation, the favorable capital cost of the proposed EPU compared to new generating capacity, and the reduction in incremental operating costs that result from EPU, make the EPU project attractive. In addition, the investment associated with the proposed EPU will result in increased revenues, thus enhancing the value of the QCNPS as a provider of electricity.

3.2 Non-Radiological Environmental Impacts

- Terrestrial Resources Effects

Land Use

The QCNPS site is flat, with facilities occupying much of its western half and open fields and areas of planted pines occupying most of its eastern half. With the exception of an industrial park just north of the site and some forested bottomlands between the developed portion of the site and the Mississippi River, the land immediately surrounding the Station is mostly agricultural, with large fields planted in grain (primarily corn) and forage crops. Areas of interest include the nearby river islands and the area adjacent to the river on the Iowa side, which are included in the Upper Mississippi River Wildlife and Fish Refuge. These areas include marshlands that are important feeding grounds for waterfowl (Ref. 2).

Approval of the proposed EPU would result in minor modifications to current land use at QCNPS. These changes are associated with a small increase in the number of fuel assemblies used in each cycle, the current QCNPS plans for dry cask storage may be increased to add an additional storage pad with an area of less than one-tenth acre. Activities over the period of construction could displace small numbers of animals (e.g., songbirds and small mammals) that forage, feed, nest, or rest in the area. These construction-related impacts would be small, intermittent, and localized. Some animals could choose to leave the area permanently, while others could become accustomed to the increased noise and activity and return to the area. Species likely to be affected (e.g., ground squirrel, rabbit, and songbirds) are common to these areas. The additional dry cask storage would not impact any historic or archaeological areas. However, there would be some minor changes to visual and aesthetic resources. The additional construction would not be visible from any major interstate highway or state highway, nor would it block the view of any historic sites or landscape vistas.

No new solid waste streams or significant contributions to existing solid waste streams are expected from the EPU, other than a transient, short-term increase in waste volume associated with installation activities. This short-term volume increase may be slightly higher than solid waste volumes generated during normal outages.

Terrestrial Biota

A relatively small number of threatened and endangered terrestrial species have been recorded in Rock Island County, Illinois, and across the river in Muscatine and Scott Counties, Iowa. Table 3-3 presents the four Federally listed threatened and endangered terrestrial species identified during 1999 in Rock Island County, Illinois (Ref. 9) and in Scott and Muscatine Counties, Iowa (Ref. 10). The proposed EPU will not disturb the habitat of these species and will not affect their distribution. Also, no significant increase in noise from the station is expected following the EPU. Therefore, no impact on terrestrial biota is expected.

Table 3-3. Federally Listed Threatened and Endangered Terrestrial Species Identified in Rock Island County, Illinois (Ref. 9) and Scott and Muscatine Counties, Iowa (Ref. 10).

Species	Status	Habitat
Western Prairie Fringed Orchid (*Platanthera praeclara*)	Threatened	Scott County Iowa; Historic: Mesic to wet prairies
Eastern Prairie Fringed Orchid (*Platanthaera leucophaea*)	Threatened	Scott and Muscatine Counties Iowa; Potential: Mesic to wet prairies
Indiana Bat (*Myotis sodalis*)	Endangered	Scott and Muscatine Counties, Iowa and Rock Island County, Illinois; Caves, mines; small stream corridors with well-developed riparian woods; upland forests
Bald Eagle (*Haliaeetus leucocephalus*)	Threatened	Scott and Muscatine Counties, Iowa, and Rock Island County, Illinois; Wintering areas with night roosts

Transmission Facilities

No changes in operating transmission voltages, onsite transmission equipment, or power line right-of-way are required to implement or support this EPU. An increase in onsite power use will be required to support new equipment associated with the EPU. Electricity to power this additional equipment will come from the existing supply system. Sufficient power is available to meet the needs of the new EPU equipment. There are no new requirements or modifications necessary for the offsite power system to maintain grid stability.

No changes in transmission facilities will be needed for the EPU. The electromagnetic field (EMF) created by transmission will be increased as an essentially linear function of power. After the EPU, power production at the QCNPS would be less than the capacity at other ComEd stations where no harmful effects from EMFs are known to have occurred.

Implementation of the EPU does not increase the probability of shock from primary or secondary currents. Transmission lines are constructed to meet or exceed requirements of the Illinois Commerce Commission General Order 160, which is identical to the National Electric Safety Code (NESC).

- Air Quality Effects

QCNPS operates two heating boilers, one auxiliary steam boiler, five diesel generators, associated fuel tanks, and other minor air emission sources. Many of these sources are integral parts of the plant safety systems and are operated periodically for test purposes. Emissions from these sources are managed such that actual emissions from the Station are less than major source thresholds as regulated under the Clean Air Act, as amended. Implementation of EPU will not increase facility air emissions.

- Hydrology Effects

QCNPS uses steam produced by the heat of nuclear fission to drive turbines that produce electricity. When steam leaves the turbine, it is condensed, demineralized, and pumped back to the reactor vessel. This system is closed and does not contact the water used to cool the condensers. Approximately 2,094 cubic feet per second (cfs) of cooling water for the condensers is pumped from the Mississippi River. The original design called for a once through, or open-cycle, cooling water system in which the heated cooling water is combined with other water discharges and returned to the river downstream of the intake. At design conditions, full power production in both units (i.e. 5,022 MWt), causes a 23° Fahrenheit (F) temperature rise in a total discharge of 2,270 cfs (Ref. 2). Expected flow, based on equipment capacity constraints and operating history, is 2,192 cfs. At a constant flow rate, the temperature increase in the cooling water is proportional to station power level. For example, if the station operates at 50 percent of full power and the cooling water flow is 2,270 cfs, the temperature rise is 11.5° F.

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 (Ref. 2). 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. Beyond the boom is a series of vertical metal bars spaced 2.5 inches apart, called the trash rack, 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.

Outlets from the cooling system have had several configurations, in response to concerns over thermal effects on the river biota. 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 (Ref. 4). This system was used for about eight months in 1972, after which a diffuser system was operated 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 is 16,000 feet long, 185 feet wide, and 9 feet deep; it had 328 spray nozzles used to cool heated water via evaporation (Ref. 4). Partial closed-cycle operation began in 1974 and both units were operated in closed-cycle mode beginning in 1975. Losses to evaporation and blowdown to the river equaled 167 cfs during closed-cycle operation, which was withdrawn from the Mississippi River. The spray canal was considerably less efficient than anticipated and, in 1979, revisions to the NPDES permit and an agreement with the stakeholders allowed partial open-cycle operation of the condenser cooling 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 NPDES permit limits under most river flow conditions (Ref. 4). To demonstrate compliance at low river flows, a temperature monitoring curve was developed that allows 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 (Ref. 5). The temperature monitoring curve was modified in 1990, using measurements taken during the drought years of 1988 and 1989 (Ref. 6).

The EPU will not change the hydrodynamics of the condenser cooling system. The potential effects of higher discharge temperatures are discussed below.

Groundwater from five wells is used at the QCNPS for domestic purposes, for raising fish in the former spray canals, and for a variety of industrial applications, not including condenser cooling. The EPU will not affect groundwater use.

Surface water withdrawal will not be affected by the EPU. The maximum flow of river water through the station will not be changed.

QCNPS operates under NPDES Permit No. IL0005037, which covers the following discharges to the Mississippi River (Ref. 11):

- 001/002 Open Cycle Diffusers
- B01 Wastewater Treatment System
- C01 Sanitary Waste Treatment Plant
- A02 Radwaste Treatment System Blowdown

The permit became effective June 1, 2000, and expires May 31, 2005. Special Condition 6 of the permit gives thermal limitations at the downstream boundary of the mixing zone, including a maximum temperature rise above natural temperature of 5 °F and maximum temperature limits for each month of the year. The special condition also requires that the mixing zone not exceed 25 percent of the cross-sectional area or volume of flow in the river, nor exceed 26 acres of the Mississippi River. Based on the temperature monitoring curve, Special Condition 6 states that compliance is demonstrated when river flows are greater than 16,000 cfs and ambient river temperature is 5 °F or more below the maximum monthly limit. For river flows between 11,000 cfs and 16,000 cfs, compliance is demonstrated by either adjusting plant load based on the correlation in the temperature monitoring curve, or by actual monitoring of river temperatures at the downstream boundary of the mixing zone. At river flows less than 11,000 cfs, the permit requires temperature monitoring at the downstream boundary of the mixing zone (Ref. 11).

QCNPS is not seeking to change the thermal limits or mixing zone requirements contained in the NPDES permit in connection with the EPU. Rather, a new temperature monitoring curve is proposed that accounts for the increased discharge temperatures associated with the EPU (Ref. 12). Under uprate conditions, the maximum condenser-water temperature rise will be 28 °F, 5 °F higher than the current maximum temperature rise of 23 °F. The revised temperature monitoring curve raises the minimum river flows required for demonstrating compliance using river temperature monitoring at the downstream boundary of the mixing zone or adjusting plant load per the temperature monitoring curve correlation. The flow at which physical river temperature monitoring must be performed or plant load adjustment must be made increases from 16,000 cfs to 21,100 cfs under the revised temperature monitoring curve.

The station monitors wastewater streams as required by the NPDES permit and only uses approved chemicals for conditioning water to prevent scaling, corrosion, and biofouling. Because an increase in the design capacity to withdraw water from the Mississippi River is not proposed for EPU, none of these practices will be altered.

- Aquatic Resources Effects

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 about half the distance from Lock and Dam 13 to Lock and Dam 14.

Effects on the riverine biota by thermal effluent from the station have been investigated by ComEd for 29 years. Studies of the lower trophic levels - phytoplankton, zooplankton, periphyton, and benthic invertebrates - were conducted from 1968 to 1977. Local effects associated with the operation of QCNPS were apparent from these studies, but overall population levels in the vicinity of the Station were not adversely affected (Ref. 4). Ichthyoplankton (fish eggs and larvae) investigations began in 1971 and were intensified from 1975 through 1985, after which they were discontinued (Ref. 4, Ref. 13). The most abundant taxa collected have consistently been freshwater drum, carp, and minnows. Effects on ichthyoplankton abundance by Station operation, including open-cycle operation, were minimal (Ref. 4).

ComEd 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 (e.g., gizzard shad, freshwater drum, emerald shiner, river shiner, carp, and bluegill) have consistently dominated collections. No verifiable effects on the fishery from Station operations have been seen (Ref. 13). Two significant changes in the Pool 14 fishery have been observed since the early 1970s, neither of which is associated with QCNPS operations. 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 ComEd. These fish are reared in the Station's inactive cooling canal and released in the Mississippi River as fingerlings. Second, the abundance of riverine fish species (e.g., freshwater drum, channel catfish, flathead catfish, and white bass) has increased while the abundance of backwater fish species (e.g., white and black crappie) has decreased as sedimentation associated with operation of the navigation channel has degraded backwater areas and sloughs (Ref. 13).

EPU will cause temperatures in the condenser cooling system to be higher than those associated with previous studies of thermal effects. River water temperature in the condenser cooling system will be raised to a maximum of 28 °F above ambient under the EPU, rather than the current maximum increase of 23 °F (Ref. 12). The higher temperature is expected to cause a higher mortality rate for organisms entrained in the system. Entrained ichthyoplankton mortality may affect more species, with the possible exception of fish that spawn early in the year (Ref. 14). However, the historical ichthyoplankton entrainment rate, which is 0.5 to 1 percent of the total drifting by the station, will not change because water withdrawals will remain the same. The overall effect of an increase in entrained plankton mortality will not be significant for the local populations involved.

Higher effluent temperatures at EPU conditions may also have an increased affect on non-motile biota in the discharge mixing zone. Drifting ichthyoplankton mortality may increase in the mixing zone because ichthyoplankton are more likely to succumb to upper lethal temperatures as opposed to a particular temperature increase (Ref. 14). This is expected to affect only species that spawn late, after the peak period of larval drift, when ambient river temperatures are high and river flow may be lower. Ichthyoplankton losses at low river flows are expected to be fairly small in total and, based on an approximate low river flow return frequency of once in 10 years, it is expected that these losses will not negatively affect recruitment to the fish community of Pool 14.

The Federally endangered mussel *Lampsilis higginsi* is not expected to be exposed to the higher temperatures associated with the uprate because its preferred habitat does not include the main channel of the Mississippi River at this location (Ref. 14). Some alteration in the timing of life cycle stages of other mussel species may occur. Adult and juvenile fish would be expected to avoid the increased temperatures in the mixing zone, and thereby not be harmed.

No fish species listed as federally threatened or endangered have been collected near the Station during the 29 years of monitoring in Pool 14. However, eight fish species listed by the States of Illinois and Iowa have been collected in the general vicinity of the diffusers (Ref. 14). Of these, grass pickerel and western sand darter are the most frequently collected. Grass pickerel is the only state-listed species in Pool 14 that may have a sustainable population. Individuals collected from other species appear only as transients in Pool 14. The grass pickerel is mainly taken in littoral and backwater areas and it is not expected to be in the main channel where elevated temperatures will occur. The western sand darter is occasionally collected in the main channel (10 specimens over a 25-year period) and could be exposed to higher temperatures in the mixing zone area. However, it is anticipated that individuals of this species will avoid the mixing zone area and move to adjacent areas as upper avoidance temperatures are approached (Ref. 14). All listed species are expected to avoid temperatures outside their preferred range that may occur in the mixing zone. Other than *Lampsilis higginsi* and the fish mentioned above, no rare species are expected to occur in the vicinity of QCNPS (Ref. 14).

Fish may become impinged on the intake structures protecting the condenser cooling water pumps because of water velocities leading into the structures and the diminished physical condition of the fish (Ref. 4). Impingement has not had a deleterious effect on fish populations in the vicinity of the station because sampling indicates that impingement affects mostly dead and moribund fish. There is no change in cooling water flow proposed for the EPU, so no differences in impingement rates are expected.

The potential for cold shock and gas bubble disease resulting from thermal effluent from QCNPS was investigated for the diffuser system (Ref. 4). No existing or potential impacts to fish were revealed. The increased temperature of the QCNPS discharge is not expected to create a cold shock because of the extended period of time required to remove heat from the reactor and the rapid heat dissipation in the NPDES permitted mixing zone. The prior conclusion (Ref. 4) of no gas bubble disease impact will not change because flow conditions will not change.

3.3 Radiological Environmental Impacts

- Radioactive Waste Streams

The radioactive waste systems at QCNPS are designed to collect, process, and dispose of radioactive wastes in a controlled and safe manner. The design bases for these systems during normal operation are to limit discharges in accordance with 10 CFR 20, to limit exposures to the requirements of 40 CFR 190, and to satisfy the design objectives of 10 CFR 50 Appendix I. Adherence to these limits and objectives will continue under the proposed EPU.

Operation at EPU conditions will not result in any physical changes to the solid waste, liquid waste, or gaseous waste systems. The safety and reliability of these systems is unaffected by the proposed EPU. Also, EPU does not affect the environmental monitoring of any of these waste streams and the radiological monitoring requirements of the QCNPS Technical Specifications will not be affected. Under normal operating conditions, EPU does not introduce any new or different radiological release pathways and does not increase the probability of an operator error or equipment malfunction that would result in an uncontrolled radioactive release from the radioactive waste streams. The specific effects of the proposed EPU on each of the radioactive waste systems are evaluated in the following paragraphs.

Solid radioactive wastes include solids recovered from the reactor process system, solids in contact with reactor process system liquids or gases, and solids used in the reactor process system operation. The largest volume of solid radioactive waste at QCNPS is low-level radioactive waste (LLRW). Sources of LLRW present at QCNPS include resins, filter sludge, dry active waste, metals, oil, etc. The annual burial volume of LLRW generated in 1998 was 228.61 cubic meters (m^3); in 1999 the burial volume decreased to 82.93 m^3; and the projected burial volume of LLRW in 2000 is approximately 140 m^3. One-time increases in the burial volume of LLRW associated with EPU installations are projected for each unit. The volume of resin is expected to increase by as much as 18 percent at EPU conditions, due to increased iron removal in the condensate system from the increased feedwater flow and the addition of condensate demineralizer vessels. An 18 percent increase in resin volume projected onto the expected year 2000 LLRW burial volume results in a 154 m^3 per year post-EPU LLRW burial volume (i.e. 10 percent increase), which is bounded by the FES.

The number of fuel assemblies will increase for any given core load with the proposed EPU, reducing storage space in the spent fuel pool. The increased spent fuel storage needs from EPU will be accommodated in the design for spent fuel dry storage casks currently planned for QCNPS pursuant to 10 CFR Part 72, Subpart K "General License for Storage of Spent Fuel at Power Reactor Sites." At current off-load rates, four dry storage casks would be filled during each refueling outage with a fifth dry storage cask partially filled. QCNPS would complete the fifth cask using the inventory of assemblies from the spent fuel pool. At EPU conditions, each refueling outage will also fill four casks and partially fill a fifth. However, fewer assemblies from the spent fuel pool will be needed to complete the fifth dry storage cask. The net effect of EPU will be to increase the number of dry storage casks needed by three to four every five years.

Liquid radioactive wastes include liquids from the reactor process systems and liquids that have become contaminated with process system liquids. Table 3-4 presents liquid releases from QCNPS for the most recent five-year period. Water processed in the liquid radioactive waste treatment system follows one of two pathways. Water that has been demineralized and purified is typically treated and reused. Water that has come in contact with organics or other impurities that make it unsuitable for reuse is treated and released. Increases in flow rate through the condensate demineralizers and increases of fission products and activated corrosion products are expected at EPU conditions, resulting in additional backwashes of condensate demineralizers and reactor water cleanup filter-demineralizers. These additional backwashes will be processed through the liquid radioactive waste treatment system and are expected to be suitable for reuse. Therefore, liquid effluent release volumes are not expected to increase significantly as a result of EPU. No changes in radioactive waste treatment are proposed. Therefore, average treatment efficiency will not change and the radioactivity of liquid effluent releases may increase up to the 18 percent proposed power uprate. Expected QCNPS liquid effluents at EPU

Table 3-4. Liquid and Gaseous Effluents 1995-1999[a].

	1995	1996	1997	1998	1999	Average 1995-1999
Liquid Effluents Released to Mississippi River (Ci)[b]						
Fission and	7.36×10^{6} l[c]	7.00×10^{6} l[c]	6.49×10^{6} l[c]	1.07×10^{7} l[c]	4.94×10^{6} l[c]	**7.29×10^{6} l[c]**
Activation Products	6.26×10^{-2}	2.52×10^{-2}	2.93×10^{-2}	3.39×10^{-2}	2.43×10^{-2} [b]	**3.50×10^{-2}**
Tritium	2.25×10^{1}	2.21×10^{1}	2.82×10^{1}	4.84×10^{1}	2.66×10^{1}	**2.95×10^{1}**
Alpha	BDL[d]	BDL[d]	BDL[d]	BDL[d]	BDL[d]	**BDL[d]**
Gaseous Effluents Released to the Atmosphere (Ci)[b]						
Fission and Activation Gases	5.50×10^{1}	2.78×10^{1}	2.70×10^{1}	3.48×10^{1}	9.68×10^{1}	**4.82×10^{1}**
Iodine-131	1.88×10^{-3}	8.79×10^{-4}	1.35×10^{-3}	1.70×10^{-3}	2.73×10^{-3}	**1.70×10^{-3}**
Beta-gamma[e]	2.07×10^{-2}	2.09×10^{-2}	1.77×10^{-2}	1.03×10^{-2}	3.13×10^{-3}	**1.45×10^{-2}**
Alpha	1.46×10^{-5}	5.16×10^{-6}	BDL[d]	6.17×10^{-5}	1.61×10^{-5}	**2.43×10^{-5}**
Tritium	3.12×10^{1}	5.18×10^{1}	7.36×10^{1}	5.83×10^{1}	1.05×10^{2}	**6.39×10^{1}**
Total	8.62×10^{1}	7.96×10^{1}	1.01×10^{2}	9.31×10^{1}	2.02×10^{2}	**1.12×10^{2}**

a. Source: (Ref. 15, 16, 17, 18, and 19)
b. Ci = curies
c. L = liters
d. BDL = Below Detectable Levels
e. Beta-gamma as particulates

NOTE: Since below detectable levels do not have an assigned quantitative value, they were not included in the average total. The average total in these cases is more conservative than rows containing all quantitative values.

conditions will continue to be within the regulatory limits of 10 CFR 50 Appendix I.

Gaseous radioactive wastes principally include activation gases and fission product radioactive noble gases vented from process equipment and, under certain conditions, the building ventilation exhaust air. The major sources of gaseous radioactive wastes are the condenser air ejector effluent and steam packing exhaust system effluent. Table 3-4 presents gaseous releases from QCNPS for the most recent five-year period. Based on the conservative assumption of a non-negligible amount of fuel leakage due to defects, radioactive releases are estimated to increase proportionally to the 18 percent EPU. However, the current and expected fuel defect rate is extremely small. Therefore, the expected gaseous effluents remain bounded by the FES.No increase in gaseous wastes is expected from any new fuel designs because ComEd's contract with General Electric contains a warranty section that requires General Electric to meet a specified level of fuel performance. This level is at least as stringent as that imposed on current fuel designs.

In summary, solid radioactive waste burial volume is expected to increase by approximately 10 percent and the radioactivity of liquid effluent releases and gaseous radioactive effluent release volume may increase up to 17 percent as a result of EPU. The liquid radioactive release volume is not expected to increase. The proposed EPU will not introduce any new or different radiological release pathways.

- Radiation Levels and Offsite Dose

Offsite dose from radioactive effluents and direct radiation is monitored at QCNPS using two types of monitoring stations: radiation monitors and sampling monitors. Direct radiation monitoring consists of two thermoluminescent dosimeters (TLDs) provided at each location to monitor the integrated radiation exposure. Sampling monitors consist of particulate and iodine air samplers. Monitoring is performed at onsite and offsite locations, as described in the Offsite Dose Calculation Manual (ODCM).

Offsite dose from liquid effluents are summarized and averaged for 1995 through 1999 (Table 3-5) according to 10 CFR 50 Appendix I as reported in the Annual Radiological Environmental Operating Reports for the station. For the five year period, average annual whole body dose was 5.23×10^{-4} mrem, and average annual dose to the critical organ was 8.17×10^{-4} mrem. The highest percentage of 10 CFR 50 Appendix I regulatory limits for maximum dose resulting from liquid releases to an adult receptor for the five year period occurred in 1998 and was 0.005 percent of the critical organ dose limit (Table 3-5). The average dose compared with 10 CFR 50 Appendix I regulatory limits from 1995 through 1999 was 0.003 percent of the regulatory limit.

No significant change in the volume of water treated and released is expected as a result of EPU. The offsite dose from liquid effluents is projected to increase proportionally to EPU due to the increase in concentration of fission products and activation products in the reactor coolant. Offsite dose will remain well below 10 CFR 50 Appendix I standards.

Doses to individuals from gaseous releases are summarized and averaged for 1995 through 1999 (Table 3-5) according to 10 CFR 50 Appendix I categories as reported in the Annual Radiological Environmental Operating Reports for the Station. For the five year period, average annual total body dose was 7.08×10^{-4} millirem (mrem) and average annual dose to the critical organ was 3.9×10^{-2} mrem. The highest percentage of 10 CFR 50 Appendix I regulatory limits for maximum dose resulting from airborne releases to an adult receptor for the five year period occurred in 1997 and was 0.23 percent of the critical organ dose limit (Table 3-5). The average dose compared with 10 CFR 50 Appendix I regulatory limits from 1995 through 1999 was 0.16 percent of the regulatory limit.

Offsite dose from gaseous effluents depends heavily on fuel performance. Current and expected fuel defect rates are significantly better than design. Conservatively assuming a non-negligible amount of fuel leakage due to defects, gaseous effluents will increase proportionally

Table 3-5. Gaseous and Liquid Effluent Dose Pathways 1995-1999.[a]

	1995	1996	1997	1998	1999	Average 1995-1999 (Regulatory limits)
Maximum Dose						
Liquid Effluent Pathways						
Whole Body (mrem)[b]	4.74×10^{-4}	4.53×10^{-4}	4.98×10^{-4}	8.36×10^{-4}	3.58×10^{-4}	**5.23×10^{-4} (3)[e]**
Critical Organ (mrem)[b]	9.64×10^{-4}	6.59×10^{-4}	7.24×10^{-4}	1.22×10^{-3}	5.21×10^{-4}	**8.17×10^{-4} (25)[d]**
Gaseous Effluent Pathways						
Gamma Air Dose (mrad)[c]	1.14×10^{-3}	5.91×10^{-4}	5.22×10^{-4}	7.31×10^{-4}	1.71×10^{-3}	**9.38×10^{-4} (15)[e]**
Skin (mrem)[b]	9.40×10^{-4}	4.92×10^{-4}	4.36×10^{-4}	6.09×10^{-4}	1.43×10^{-3}	**7.81×10^{-4} (10)[e]**
Beta Air Dose (mrad)[c]	9.60×10^{-5}	5.07×10^{-5}	4.97×10^{-5}	6.75×10^{-5}	1.67×10^{-4}	**8.61×10^{-5} (20)[e]**
Critical Organ (mrem)[b]	3.48×10^{-2}	2.79×10^{-2}	5.66×10^{-2}	3.74×10^{-2}	4.11×10^{-2}	**3.96×10^{-2} (25)[d]**
Whole Body (mrem)[b]	8.56×10^{-4}	4.47×10^{-4}	3.94×10^{-4}	5.52×10^{-4}	1.29×10^{-3}	**7.08×10^{-4} (25)[d]**
Infant Thyroid (mrem)[b]	3.51×10^{-2}	2.61×10^{-2}	4.81×10^{-2}	2.92×10^{-2}	3.17×10^{-2}	**3.40×10^{-2} (15)[e]**
Sky Shine						
Whole Body (mrem)[b]	3.73×10^{0}	9.56×10^{0}	1.36×10^{0}	5.15×10^{0}	9.38×10^{0}	**5.84×10^{0} (25)[d]**

a. Source: (Ref. 15, 16, 17, 18, and 19)
b. mrem = millirem
c. mrad = millirad
d. 40 CFR 190
e. 10 CFR 50, Appendix I
Note: Regulatory limits specify a generic organ dose limit, nuclide specific critical organ limits may be lower depending on effluent composition.

to the 18 percent EPU. However, offsite dose will remain well below 10 CFR 50 Appendix I standards.

Calculated offsite dose resulting from direct radiation due to radiation levels in plant components (i.e. sky shine) will increase up to 18 percent because the ODCM conservatively proportions offsite dose to power generation. Since sky shine is the dominant contributor to total offsite dose, the calculated total offsite dose from the ODCM will increase up to 18 percent. Actual offsite dose from sky shine is not expected to increase significantly because the decrease in transit time is expected to result in a minimal change in concentration through reduced decay time and because the expected activity concentration in the steam will remain constant due to the dilution effect of a 19 percent increase in steaming rate. The expected dose at EPU conditions will remain significantly below the standards of 10 CFR 20, 10 CFR 50 Appendix I, and 40 CFR 190.

- Occupational Radiation Exposure

Radiation levels and associated doses are controlled by the As Low As Reasonably Achievable (ALARA) program as required by 10 CFR 20.

ComEd has a policy to maintain occupational dose equivalents to the individual and the sum of dose equivalents received by all exposed workers to ALARA levels. This ALARA philosophy is implemented in a manner consistent with QCNPS operating, maintenance, and modification requirements and accounts for the state of technology, the economics of improvements relative to the state of technology, the economics of improvements relative to public health and safety benefits, the public interest relative to utilization of nuclear energy and licensed materials, and other societal and socioeconomic considerations.

The QCNPS ALARA program manages exposure by:

A. Minimizing the time personnel spend in radiation areas,

B. Maximizing the distance between personnel and radiation areas, and

C. Maximizing shielding to minimize radiation levels in routinely occupied plant areas and in the vicinity of plant equipment requiring attention.

Shielding is used throughout the station to protect personnel against radiation emanating from the reactors, the turbines, and their auxiliary systems, and to limit radiation damage to operating equipment. ComEd has determined that the current shielding designs are adequate for any dose increase that may occur after the EPU.

For EPU, normal operation radiation levels will increase by no more than the percentage increase of EPU. For conservatism, many aspects of the plant were originally designed for higher-than-expected radiation sources. Thus, the increase in radiation levels does not affect radiation zoning or shielding in the various areas of the plant because it is offset by conservatism in the original design, source terms used, and analytical techniques (Ref. 20). Therefore, no new dose reduction programs are scheduled and the ALARA program will continue in its current form.

At EPU conditions, a potential source of increased occupational radiation results from a projected increase in moisture carryover from the reactor vessel steam dryer/separator to the main steam lines. To reduce moisture content under EPU conditions, modifications to the steam dryer/separator will be required. These modifications are expected to result in a negligible increase in occupational exposure.

3.4 Environmental Impacts of Accidents

The term "accident" refers to any unintentional event (i.e., outside the normal or expected plant operational envelope) that results in the release or a potential for release of radioactive materials to the environment. The realistic consequences of postulated accidents presented in Table 3-6 were calculated by the AEC and published in the FES (Ref. 2). The accident scenarios for this assessment follow the realistic guidance provided in Regulatory Guide 4.2. The radiological dose consequences are provided as fractions of 10 CFR 20 limits. The realistic assessments

Table 3-6. Summary of Radiological Consequences of Postulated Accidents.[a]

Class	Event	Estimated Fraction of 10 CFR Part 20 Limit at Site Boundary[b]	Estimated Dose to Population in 50-mile Radius, person-rem
1.0	Trivial incidents	(c)	(c)
2.0	Small releases outside containment	(c)	(c)
3.0	Radwaste system failures		
3.1	Equipment leakage or malfunction	0.29	10
3.2	Release of waste gas storage tank contents	1.1	40
3.3	Release of liquid waste storage tank contents	0.001	<0.1
4.0	Fission products to primary system (BWR)		
4.1	Fuel cladding defects	(c)	(c)
4.2	Off-design transients	0.012	1.0
5.0	Fission products to primary and secondary systems (PWR)	NA[d]	NA[d]
6.0	Refueling accidents		
6.1	Fuel bundle drop	<0.001	<0.1
6.2	Heavy object drop onto fuel in core	0.002	0.73
7.0	Spent fuel handling accident		
7.1	Fuel assembly drop in fuel storage pool	<0.001	0.16
7.2	Heavy object drop onto fuel rack	<0.001	0.30
7.3	Fuel cask drop	0.42	15
8.0	Accident initiation events considered in design basis evaluation in the safety analysis report		
8.1	Loss-of-coolant accidents		
	Small break	<0.001	<0.1
	Large break	0.002	9.9
8.1(a)	Break in instrument line from primary system that penetrates the containment	<0.001	<0.1
8.2(a)	Rod Ejection Accident (PWR)	NA[d]	NA[d]
8.2(b)	Rod drop accident	0.014	1.2
8.3(a)	Steamline breaks (PWR-outside containment)	NA[d]	NA[d]
8.3(b)	Steamline breaks (BWR)		
	Small break	0.01	0.35
	Large break	0.051	1.8

Source: (Ref. 2).

a. The doses calculated as consequences of the postulated accidents are based on airborne transport of radioactive materials resulting in both a direct and an indirect exposure pathway.

b. Represents the calculated whole body dose as a fraction of 500 mrem (or the equivalent dose to organ).

c. These releases will be comparable to the design objective indicated in the proposed Appendix I to 10 CFR 50 for routine effluents (i.e., 5 mrem/yr to an individual from either gaseous or liquid effluents).

d. NA = Not applicable.

made for environmental impact studies result in lower doses than those which would be seen for the conservative design basis safety assessments (Ref. 21). Because of the different scenarios, the accident consequences of the realistic assessments in the FES and the conservative, design-bases assessments of the UFSAR are not comparable.

The results presented in Table 3-6 could be recalculated for the 18 percent higher EPU power level. The resulting doses would be approximately 18 percent higher. Since the doses from the realistic accident analysis of Table 3-6 are currently well within 10 CFR 20 limits, an 18 percent increase results in doses that also remain well within these limits. Therefore, the realistic consequences of the accidents under EPU conditions are acceptable.

3.5 Environmental Effects of Decommissioning

The environmental effects of decommissioning were not evaluated in the FES. The ability to maintain sufficient financial reserves for decommissioning is not affected by EPU. The environmental effects of decommissioning will be addressed in the QCNPS decommissioning plan that will be submitted according to the applicable regulatory requirements. EPU may impact decommissioning due to increases in feedwater flow rate and increased neutron fluence. These effects could increase the amount of activated corrosion products and consequently increase post-shutdown radiation levels.

4.0 ALTERNATIVES

This section evaluates the environmental impacts of alternatives to the QCNPS proposed EPU. Unit 1 and Unit 2 will each be uprated from 2,511 MWt to 2,957 MWt, resulting in a gross increase of approximately 206 MWe for both units. The discussion includes an assessment of the "no action" alternative and alternatives that meet incremental changes in system generating capacity.

4.1 No-Action Alternative

ComEd is using the "no-action" alternative to refer to a scenario in which the station continues to operate under current power levels. Under this alternative, station operation and associated environmental impacts would not be any different from those currently allowed through various permits approved by the regulatory agencies.

4.2 Alternatives That Meet Incremental Changes in System Generating Capacity

Based on 1998 generation data for the State of Illinois (Ref. 22), the primary energy sources for electric generation are coal (53.6 percent), nuclear (42.4 percent), gas (3.4 percent), and petroleum (0.6 percent). ComEd has concluded that pulverized coal- and gas-fired units are the only reasonable alternatives to EPU for incremental increases in generation capacity.

Recently, the electric utility industry within the State of Illinois began the process of restructuring (i.e., deregulation). It is expected that the State will be fully deregulated by May 1, 2002 (Ref. 23). It is generally perceived that a deregulated market will provide the benefits of lower energy costs, greater choice for customers, and economic efficiency. A number of companies have proposed to construct new generating facilities in Illinois since the deregulation law was enacted. Citizens, local governments, and legislators objected to a number of the proposed plants. In response, the Illinois Pollution Control Board has been conducting hearings to evaluate whether additional siting and/or other regulation of such proposed plants should be recommended (Ref. 7). Regardless of which entities construct and operate the replacement power supply, certain environmental parameters would be constant among these alternative power sources. Therefore, ComEd will discuss the impacts of these reasonable alternatives for the QCNPS EPU.

4.2.1 Construct and Operate a Fossil-Fuel-Fired Generating Station

ComEd analyzed hypothetical new coal- and gas-fired units at the existing QCNPS site. Under this approach, QCNPS would construct a separate generating facility, but would minimize certain environmental impacts by building on previously disturbed land and by utilizing existing facilities, transmission lines, roads and parking areas, office buildings, and cooling systems to the greatest extent practicable.

For comparability in analysis, ComEd selected coal- and gas-fired units of equal electric power and equal capacity factors. Therefore, to meet the demands of the proposed EPU presented in Section 4.0, ComEd selected alternative units of 206 gross MWe. It must be emphasized, however, that these are hypothetical scenarios and ComEd does not have plans for such construction at QCNPS.

Coal-Fired Generation

The NRC, in considering extension of the operating licenses for Calvert Cliffs (Ref. 24) and Oconee (Ref. 25) Nuclear Stations, evaluated coal-fired generation alternatives. For Calvert Cliffs, NRC analyzed three 600-MWe units and for Oconee, NRC analyzed four 522 MWe units and two 1,185 MWe units. ComEd has reviewed the NRC analysis and believes it to be sound. Therefore, ComEd has used site- and Illinois-specific input and has scaled from the NRC analysis, where appropriate.

Table 4-1 presents the basic coal-fired alternative emission control characteristics. ComEd 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. Coal and limestone (or lime) would be delivered via rail line to an existing rail spur that leads to QCNPS. The rail system at QCNPS would require modifications to handle these increased rail deliveries.

Table 4-1. Coal-Fired Alternative.

Characteristic	Basis
Unit size = 206 MW ISO rating gross[a]	Chosen as equal to proposed extended power uprate
Unit size = 194 MW ISO rating net[a]	Calculated based on 6 percent onsite power usage (ComEd experience): 206 MW x 0.94
Boiler type = tangentially fired, dry-bottom	Minimizes nitrogen oxides emissions (Ref. 26, Table 1.1-3 page 1.1-17).
Fuel type = bituminous, pulverized coal	Typical for coal used in Illinois (ComEd experience)
Fuel heating value = 9,706 Btu/lb	1998 value for coal used in Illinois (Ref. 27, Table 28)
Fuel ash content by weight = 7.1 percent	1998 value for coal used in Illinois (Ref. 27, Table 28)
Fuel sulfur content by weight = 1.12 percent	1998 value for coal used in Illinois (Ref. 27, Table 28)
Uncontrolled NO_x emission = 9.7 lb/ton Uncontrolled CO emission = 0.5 lb/ton	Typical for pulverized coal, tangentially fired, dry-bottom, pre-NSPS with low- NO_x burner (Ref. 26, Table 1.1-3, page 1.1-17)
Heat rate = 10,200 Btu/kWh	Typical for coal-fired, single-cycle steam turbines (Ref. 28, page 106)
Capacity factor = 0.75	Typical for small coal-fired units (ComEd experience)

Table 4-1. (Continued).

Characteristic	Basis
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 (Ref. 26, Table 1.1-2, page 1.1-14).
Particulate control = fabric filters (baghouse-99.9 percent removal efficiency)	Best available for minimizing particulate emissions (Ref. 26, pages 1.1-6 and -7)
SO_x control = Wet scrubber-lime/limestone (95 percent removal efficiency)	Best available for minimizing SO_x emissions (Ref. 26, Table 1.1-1, page 1.1-13)

a. The difference between "net" and "gross" is electricity consumed onsite.
Btu = British thermal unit
ISO rating = International Standards Organization rating at standard atmospheric conditions of 59°F, 60 percent relative humidity, and 14.696 pounds of atmospheric pressure per square inch
kWh = kilowatt hour
NSPS = New Source Performance Standard
lb = pound
MW = megawatt
NO_x = nitrogen oxides
SO_x = sulfur oxides

Gas-Fired Generation

ComEd has chosen to evaluate gas-fired generation using combined-cycle turbines because it has determined that the technology may be sufficiently mature, economical, and feasible for implementation at QCNPS. Gas-fired combined-cycle turbines are readily available in a standard-sized unit of 206 MWe and are more economical than customized units. Therefore, ComEd selected this unit size. Table 4-2 presents the basic gas-fired alternative characteristics. Employing this alternative would require, as a minimum, a new 16-inch dedicated, high-pressure pipeline extended at least five miles to the Station. A constant supply of natural gas may not be readily available from this source, leading to further supply and reliability issues.

Table 4-2. Gas-Fired Alternative.

Characteristic	Basis
Unit size = 206 MW ISO rating gross:[a] One 137-MW combustion turbine and a 69-MW heat recovery boiler	Chosen as equal to proposed EPU
Unit size = 198 MW ISO rating net:[a] One 132-MW combustion turbine and a 66-MW heat recovery boiler	Calculated based on 4 percent onsite power usage
Fuel type = natural gas	Assumed
Fuel heating value = 1,018 Btu/ft^3	1998 value for gas used in Illinois (Ref. 27, Table 28)

Table 4-2. (Continued).

Characteristic	Basis
Fuel sulfur content = 0.0034 lb/MMBtu	Used when sulfur content is not available (Ref. 29, Table 3.1-2a, page 3.1-11)
NO_x control = selective catalytic reduction (SCR)	Best available for minimizing NO_x emissions (Ref. 30, Table 3.1 Database)
Fuel NO_x content = 0.0128 lb/MMBtu	Typical for SCR-controlled gas fired units (Ref. 30, Table 3.1 Database)
Fuel CO content = 0.0168 lb/MMBtu	Typical for SCR-controlled gas fired units (Ref. 30, Table 3.1 Database)
Heat rate = 8,200 Btu/kWh	Typical for combined cycle gas-fired turbines (Ref. 28, page 106)
Capacity factor = 0.75	Assumed same as coal for comparison

a. The difference between "net" and "gross" is electricity consumed onsite.
Btu = British thermal unit
CO = carbon monoxide
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
MW = megawatt
NO_x = nitrogen oxides

4.3 Environmental Impacts of Alternatives

This section evaluates the environmental impacts from potentially available alternatives for the incremental increase in power that would be generated as a result of the approval of an amendment to the operating license for QCNPS Units 1 and 2.

4.3.1 Coal-Fired Generation

The coal-fired alternative that ComEd has defined in Section 4.2.1 would be located at the existing QCNPS site on previously disturbed land, thus reducing construction impacts. The alternative would use the infrastructure of the existing cooling water system and operate within the bounds of existing NPDES permits, thereby minimizing aquatic impacts from operations. For this comparison, it is also assumed that the heat rejection from a coal-fired generating unit would be equivalent to EPU. Therefore, ComEd has limited its detailed evaluation to impacts that would be different with implementation of the EPU. These impacts are associated with changes in air quality, waste management, and land use.

Air Quality

Air quality impacts of coal-fired generation are considerably different from those of nuclear power. A coal-fired plant would emit sulfur oxides (SO_x), nitrogen oxides (NO_x), carbon monoxide (CO), and particulate matter (PM), all of which are regulated pollutants as well as carbon dioxide (CO_2), a potential contributor to global warming. SO_x, NO_x and CO would all be emitted in quantities in excess of major source thresholds. This may require emission offsets, the purchase of emission credits, or other control techniques beyond the combination of boiler technology and post-combustion pollutant removal assumed in this analysis. Coal-fired generation could also emit low levels of mercury and other toxic compounds adding to the atmospheric deposition of these pollutants. ComEd estimates the coal-fired alternative emissions to be as follows:

SO_x = 757 tons per year
NO_x = 172 tons per year
CO = 178 tons per year
Total suspended particulates (TSP) = 25 tons per year
PM_{10} (PM diameter is less than 10 microns) = 6 tons per year

Table 4-3 presents the equations ComEd used to calculate these emissions from the characteristics described in Table 4-2.

Emissions of NO_x from the electric power industry in Illinois increased by 3 percent from 1988 to 1998 (Ref. 22). In 1998, the EPA promulgated the NO_x SIP (State Implementation Plan) Call regulation that required 22 states to reduce their NO_x emissions by over 30 percent to address national ozone transport (Ref. 31). The NO_x SIP Call imposes a NO_x "budget" to limit the NO_x emissions from each state. The Illinois EPA allocated NO_x credits among the existing electrical generating units in the state. Beginning May 31, 2004, each electrical 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. New sources of NO_x must obtain enough NO_x credits to cover their annual emissions either from the set aside pool or by buying NO_x credits from other sources.

The acid rain requirements of the Clean Air Act Amendments capped the nation's sulfur dioxide (SO_2) emissions from power plants. Each utility was allocated SO_2 allowances. To be in compliance with the Act, ComEd must hold enough allowances to cover its annual SO_2 emissions. ComEd may have to purchase additional allowances from the open market in order to operate a fossil-fuel-burning plant at QCNPS.

The NRC noted that adverse human effects from coal combustion have led to important Federal legislation in recent years and that public health risks, such as cancer and emphysema, are associated with coal combustion. The NRC also identified global warming and acid rain as potential impacts of coal-fired power plants. Global warming, ozone transport, mercury deposition, and acid rain are among the significant air quality concerns associated with operating coal-fired power plants. There are numerous, stringent state and federal air pollution control requirements applicable to the construction and operation of such plants, with which ComEd would be required to comply for a proposed coal-fired plant at QCNPS. ComEd concludes that the coal-fired alternative would have moderate impacts on air quality and that these impacts may be noticeable, but they would not destabilize the resource.

Table 4-3. Air Emissions from Coal-Fired Alternative Using System Characteristics Listed in Table 4-1.

Parameter	Calculation	Result
Annual coal consumption	$1\text{ units} \times \frac{206\text{ MW}}{\text{unit}} \times \frac{10{,}200\text{ Btu}}{\text{kW} \times \text{hr}} \times \frac{1{,}000\text{ kW}}{\text{MW}} \times \frac{\text{lb}}{9{,}706\text{ Btu}} \times \frac{\text{ton}}{2{,}000\text{ lb}} \times 0.75 \times \frac{24\text{ hr}}{\text{day}} \times \frac{365\text{ day}}{\text{yr}}$	711,152 tons of coal per year
SO_2	$\frac{38^{a} \times 1.12\text{ lb}}{\text{ton}} \times \frac{\text{ton}}{2{,}000\text{ lb}} \times \left(1 - \frac{95}{100}\right) \times \frac{711{,}152\text{ tons}}{\text{yr}}$	757 tons SO_2 per year
NO_x	$\frac{9.7\text{ lb}}{\text{ton}} \times \frac{\text{ton}}{2{,}000\text{ lb}} \times \left(1 - \frac{95}{100}\right) \times \frac{711{,}152\text{ tons}}{\text{yr}}$	172 tons NO_x per year
CO	$\frac{0.5\text{ lb}}{\text{ton}} \times \frac{\text{ton}}{2{,}000\text{ lb}} \times \frac{711{,}152\text{ tons}}{\text{yr}}$	178 tons CO per year
TSP	$\frac{10^{a} \times 7.1\text{ lb}}{\text{ton}} \times \frac{\text{ton}}{2{,}000\text{ lb}} \times \left(1 - \frac{99.9}{100}\right) \times \frac{711{,}152\text{ tons}}{\text{yr}}$	25 tons TSP per year
PM_{10}	$\frac{2.3^{a} \times 7.1\text{ lb}}{\text{ton}} \times \frac{\text{ton}}{2{,}000\text{ lb}} \times \left(1 - \frac{99.9}{100}\right) \times \frac{711{,}152\text{ tons}}{\text{yr}}$	6 tons PM_{10} per year

a. Emission factors for pulverized coal, dry bottom, tangentially fired, bituminous Pre-NSPS with low-NO_x burner (Ref. 26, Tables 1.1-3 and 1.1-4)

CO = carbon monoxide
NO_x = oxides of nitrogen
PM_{10} = particulates having diameter less than 10 microns
SO_2 = sulfur oxides
TSP = total suspended particulates

Waste Management

In the Generic Environmental Impacts Statement for License Renewal of Nuclear Plants (GEIS), the NRC concluded that operation of a coal-fired alternative would generate substantial solid waste (Ref. 32). ComEd concurs with this assessment. The coal-fired plant would consume approximately 711,152 tons of coal per year having an ash content of 7.1 percent (Tables 4-1 and 4-3). After combustion, most (99.9 percent) of this ash, approximately 50,441 tons per year, would be collected along with approximately 41,284 tons per year of scrubber sludge (based on annual lime usage of 13,935 tons). ComEd estimates that ash and scrubber waste disposal over the next 20 years of plant operation would require 24 acres of land for disposal, based on a standard 30-foot waste pile (Table 4-4). ComEd recycled 87 percent of its coal ash from larger plants in 1998 and could conceivably apply this program to wastes generated at QCNPS, thus reducing the land required for disposal.

ComEd believes that, with proper siting, waste management, and monitoring practices, waste disposal would not destabilize any resource. There is potential space within the QCNPS footprint for this disposal. Most of the land needed could be obtained by converting approximately 24 acres of previously disturbed land to waste disposal (less with recycling). Significant engineering and public relations issues may develop from siting a land disposal unit at QCNPS. The Illinois EPA maintains strict construction standards for disposal facilities which may be cost prohibitive to implement or add to the complexity of the operation (i.e. leachate collection and treatment systems). Additionally, negative public reaction to a land disposal unit in close proximity to residential areas may make on-site management of solid wastes unattractive. The landfill would most likely be above grade due to the proximity to the river and the local groundwater table. After closure, the area would have limited value. For these reasons, ComEd believes that waste disposal for the coal-fired alternative could have a significant impact on the local area. However, ComEd believes the impacts could be managed so that they would be minor and they would neither destabilize nor noticeably alter any resource in the area.

Other Impacts

Construction of the power block and coal storage area would impact some land area and associated terrestrial habitat but, because most of this is a previously disturbed land at an existing industrial site, maximizing use of existing facilities would minimize impacts. Visual impacts would be consistent with the industrial nature of the site. As with any large construction project, some erosion, sedimentation, and fugitive dust emissions could be anticipated, but would be minimized by using best management practices. Construction debris from clearing and grubbing could be disposed of onsite and municipal waste disposal capacity is available. Socioeconomic impacts from the construction workforce

Table 4-4. Calculation of Solid Waste from Coal-Fired Alternative.

Parameter	Calculation	Result
SO_2 generated	$\frac{1.12 \text{ tons S}}{100 \text{ tons coal}} \times \frac{711{,}152 \text{ tons}}{\text{yr}} \times \frac{64.100 \text{ tons } SO_2}{32.066 \text{ tons S}}$	15,922 tons SO_2 per year
SO_2 removed	$\frac{1.12 \text{ tons S}}{100 \text{ tons coal}} \times \frac{711{,}152 \text{ tons}}{\text{yr}} \times \frac{64.100 \text{ tons } SO_2}{32.066 \text{ tons S}} \times \frac{95}{100}$	15,126 tons SO_2 per year
Ash generated	$\frac{7.10 \text{ tons ash}}{100 \text{ tons coal}} \times \frac{99.9}{100} \times \frac{711{,}152 \text{ tons}}{\text{yr}}$	50,441 tons ash per year
Annual lime consumption	$\frac{15{,}922 \text{ tons } SO_2}{\text{yr}} \times \frac{56.1 \text{ tons CaO}}{64.1 \text{ tons } SO_2}$	13,935 tons CaO per year
Annual calcium sulfate generation	$\frac{15{,}126 \text{ tons } SO_2}{\text{yr}} \times \frac{172 \text{ tons } CaSO_4 * 2H_2O}{64.1 \text{ tons } SO_2}$	40,587 tons $CaSO_4*2H_2O$ per year
Annual scrubber waste generation	$\frac{13{,}935 \text{ tons CaO}}{\text{yr}} \times \frac{100-95}{100} + 40{,}587 \text{ tons } CaSO_4 2H_2O$	41,284 tons scrubber waste per year
Total volume of scrubber waste	$\frac{41{,}284 \text{ tons}}{\text{yr}} \times 20 \text{ yr} \times \frac{2000 \text{ lb}}{\text{ton}} \times \frac{ft^3}{144.8 \text{ lb}}$	11,406,889 ft^3 Scrubber waste
Total volume of ash generated	$\frac{50{,}441 \text{ tons}}{\text{yr}} \times 20 \text{ yr} \times \frac{2000 \text{ lb}}{\text{ton}} \times \frac{ft^3}{100 \text{ lb}}$	20,176,522 ft^3 Ash
Total volume of solid waste	$11{,}406{,}889 \, ft^3 + 20{,}176{,}522 \, ft^3$	31,583,411 ft^3 Solid waste
Waste pile area (acre)	$\frac{31{,}583{,}411 \, ft^3}{30 \text{ ft high}} \times \frac{\text{acre}}{43{,}560 \, ft^2}$	24 acres Solid waste

Sources: Ref. 33; Ref. 34.

a. Calculations based on wet-scrubber-lime SO_2 control method and an annual coal consumption of 711,152 tons
b. Calculations performed using stoichometric ratios from $CaO+SO_2+2H_2O+1/2O_2 \Rightarrow CaSO_4*2H_2O$
c. Calculations assume 100 percent combustion of coal
d. Limestone consumption is based on SO_2 generated and Calcium Sulfate generated is based on SO_2 removed
e. Total sludge generated includes scrubbing media carryover in the waste. Density of Coal bottom ash is 100 b/ft^3 (Ref. 35)
f. Density of Calcium Sulfate Dihydrate is 144.8 lb/ft^3
g. Assume plant life of 20 years and waste pile height of 30 ft.

would be minimal, because worker relocation would not be expected due to the proximity of QCNPS to the metropolitan areas of Davenport and Bettendorf, Iowa, and Rock Island and Moline, Illinois. Cultural resource impacts would not be expected because of the previously disturbed nature of the site. However, as land is cleared for waste disposal, ComEd would identify any cultural resources (e.g., historic places and archaeological sites) and develop mitigation plans for affected resources in consultation with the Illinois State Historical Preservation Office. The effects of mining and transporting 711,152 tons of coal per year and 13,935 tons of lime/limestone per year were not evaluated, but are generally accepted to have significant environmental impacts. For example, coal mining consequences include air quality impacts from fugitive dust, water quality impacts from acidic runoff, and aesthetic and cultural resources impacts (Ref. 32).

Operation using the existing intake and discharge diffuser within the boundaries of the existing NPDES permit would minimize impacts to aquatic resources and water quality. The additional stacks, boilers, and rail deliveries would be an incremental addition to the visual impact from existing QCNPS structures and operations. Socioeconomic impacts could result from the increase in operational workforce by 80 to 90 employees at QCNPS; however, ComEd believes these impacts would be small and would be mitigated by the site's proximity to large metropolitan areas (Davenport and Bettendorf, Iowa, and Rock Island and Moline, Illinois). ComEd also assumes that the other construction and operation impacts would be small. In some cases, the impacts would not be detectable and, in all cases, they would be minor and would neither destabilize nor noticeably alter any important attribute of the resource involved. Due to the minor nature of these other impacts, mitigation would not be warranted beyond that mentioned.

4.3.2 Gas-Fired Generation

NRC evaluated environmental impacts from gas-fired generation alternatives in the GEIS, focusing on combined-cycle plants (Ref. 32). Section 4.2.1 presents ComEd's reasons for defining the gas-fired generation alternative as a combined cycle plant at the QCNPS. Land-use impacts at QCNPS from gas-fired units would be less than those from the coal-fired alternative. Reduced land requirements, due to construction on the existing site, a smaller facility footprint, and no ash or lime sludge disposal would reduce impacts to ecological, aesthetic, and cultural resources as well. An additional workforce of 10 to 20 employees required to operate the gas-fired facility would have minor socioeconomic impacts, if any. Human health concerns associated with air emissions, waste generation, and aquatic biota losses due to cooling water withdrawals and discharges would all be impacts of concern.

<u>Air Quality</u>

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

SO_x = 13 tons per year
NO_x = 47 tons per year
CO = 62 tons per year
TSP = 7 tons per year = PM_{10} (i.e. all PM is PM_{10})

Table 4-5 provides the equations used by ComEd to calculate these emissions based on the plant characteristics outlined in Table 4-2.

The additional emissions of NO_x and CO when added to current facility emissions, would make the station major sources for these criteria pollutants. The Section 4.3.1 discussion of regional air quality and Clean Air Act requirements is generally applicable to the gas-fired generation alternative. The effects of gas-fired generation on ozone levels, SO_2 allowances, and NO_x emission offsets could all be issues of concern. While gas-fired turbine emissions are less than coal-fired boiler emissions, regulatory requirements are not less stringent and the emissions are still significant. Air quality impacts would be substantially less than those of coal-fired generation, but would still require emission offsets, the purchase of emission credits, control technologies, or other mitigative measures. ComEd concludes that air emission impacts from the gas-fired alternative would be moderate.

Waste Management

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

Other Impacts

As with the coal-fired alternative, constructing the gas-fired alternative at an existing site (such as QCNPS) would reduce construction-related impacts. 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, and operation of the gas-fired facility would require 10 to 20 additional employees. ComEd believes this impact would be negligible and would be mitigated by the site's proximity to large metropolitan areas.

Table 4-5. Air Emissions from Gas-Fired Alternative Calculated with System Characteristics from Table 4-2.

Parameter	Calculation	Result
Annual gas consumption	$1\text{ units} \times \frac{137\text{ MW}}{\text{unit}} \times \frac{8{,}200\text{ Btu}}{\text{kW} \times \text{hr}} \times \frac{1{,}000\text{ kW}}{\text{MW}} \times 0.75 \times \frac{\text{ft}^3}{1{,}018\text{ Btu}} \times \frac{24\text{ hr}}{\text{day}} \times \frac{365\text{ day}}{\text{yr}}$	7,265,051,788 ft^3 per year
Annual Btu input	$\frac{7{,}265{,}051{,}788\text{ ft}^3}{\text{yr}} \times \frac{1{,}018\text{ Btu}}{\text{ft}^3} \times \frac{\text{MMBtu}}{10^6\text{ Btu}}$	7,395,823 MMBtu per year
SO_2	$\frac{0.0034\text{ lb}}{\text{MMBtu}} \times \frac{\text{ton}}{2{,}000\text{ lb}} \times \frac{7{,}395{,}823\text{ MMBtu}}{\text{yr}}$	13 tons SO_2 per year
NO_x	$\frac{0.0128\text{ lb}}{\text{MMBtu}} \times \frac{\text{ton}}{2{,}000\text{ lb}} \times \frac{7{,}395{,}823\text{ MMBtu}}{\text{yr}}$	47 tons NO_x per year
CO	$\frac{0.0168\text{ lb}}{\text{MMBtu}} \times \frac{\text{ton}}{2{,}000\text{ lb}} \times \frac{7{,}395{,}823\text{ MMBtu}}{\text{yr}}$	62 tons CO per year
TSP	$\left(\frac{0.0019\text{ lb}}{\text{MMBtu}}\right)^{a} \times \frac{\text{ton}}{2{,}000\text{ lb}} \times \frac{7{,}395{,}823\text{ MMBtu}}{\text{yr}}$	7 tons filterable TSP per year
PM_{10}	$\frac{7\text{ tons TSP}}{\text{yr}}$	7 tons filterable PM_{10} per year

a. Emission factor for filterable particulate matter, (Ref. 29, Table 3.1-2a

CO = carbon monoxide
NO_x = oxides of nitrogen
PM_{10} = particulates having diameter less than 10 microns
SO_2 = sulfur oxides
TSP = total suspended particulates

One costly (i.e., approximately $1 million per mile) and potentially controversial action with potential ecological impacts would be the installation of a minimum of five miles of buried, 16-inch gas pipeline to QCNPS. The pipeline would require approximately 90 acres for an easement. ComEd 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). These animals are common throughout the area and ComEd expects negligible reduction in their populations as a result of construction. ComEd does not expect that installation of a pipeline would create a long-term reduction in the local or regional diversity of plants and animals.

Cultural Resources

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

5.0 COM PERMITS AND CONSULTATIONS

Table 5-1 lists environmental authorizations that ComEd has obtained for current QCNPS operations. In this context, "authorizations" include permits, licenses, approvals, and other entitlements.

Table 5-1. Quad Cities Nuclear Power Station Environmental Authorizations for Current Operations.

Agency	Authority	Requirement	Number	Expires	Activity Covered
U.S. Nuclear Regulatory Commission	Atomic Energy Act (42 USC 201 et seq.)	Facility Operating License	DPR-29 (Unit 1) DPR-30 (Unit 2)	12/14/12	Operation of Units 1 and 2
U.S. Department of Transportation	49 CFR, Subpart G	Registration	515000180381	6/30/01	Hazardous materials shipments
IEPA	Federal Clean Water Act (33 USC 1251 et seq.); Title 35 IAC, Subtitle C, Ch. 1	NPDES Permit	IL0005037	5/31/05	Plant discharges to Mississippi River
IEPA	Federal Clean Air Act, Title V; IRS Ch. 111-1/2, Sec. 1039	Federally Enforceable State Operating Permit (FESOP)	161807AAB	6/30/00 Renewal started 9/01/99	Air emission source operation
Army Corps of Engineers	Rivers & Harbors Act (33 USC 403); Clean Water Act (33 USC 1344); (33 CFR 323)	Dredging Permit	CENCR-0D-S-297290	12/31/04	Dredging near water intake
IEPA	Federal Clean Air Act, Title V; IRS Ch. 111-1/2, Sec. 1039	Open Burning Permit	ID# 031600; Location ID# 161807AAB	2/16/01	Burning for Fire Fighter Training
IEPA	IRS Ch. 111-1/2 Sec. 1039	Permit	1997-EA-3026	3/1/02	Dredge Material Sedimentation Pond
IEPA	35 IAC 391	Permit	1999-SC-3002-1	3/1/04	Land Application of STP Sludge
IEPA	Resource Conservation & Recovery Act (RCRA) (42 USC 6901)	RCRA Part A Permit	ILD060862810	Not Applicable	Storage of radioactive hazardous (i.e. mixed) waste

Table 5-1. (Continued).

Agency	Authority	Requirement	Number	Expires	Activity Covered
IDNS	32 IAC 609	Waste Tracking Permit	IL0102	Not Applicable	Tracking system for shipments of LLRW
IDNS	32 IAC 330	Material License	IL-01500-01	2/28/05	Licensing of radioactive material
Department of Public Health	77 IAC 900	Registration	Facility ID# 0110833	12/31/00	Non-Community Public Water Supply Registration

USC = United States Code
IEPA = Illinois Environmental Protection Agency
IAC = Illinois Administrative Code
IRS = Illinois Revised Statutes
IDNS = Illinois Department of Nuclear Safety

6.0 ENVIRONMENTAL EFFECTS OF URANIUM FUEL CYCLE ACTIVITIES

6.1 Compliance with 10 CFR 51.51, Uranium Fuel Cycle Environmental Data (NRC Table S-3)

NRC regulations 10 CFR 51.51 provides Table S-3, Table of Uranium Fuel Cycle Environmental Data. The table, reproduced here as Table 6-1, provides the basis for evaluating the contribution to the environmental effects of the following:

Uranium mining and milling

Production of uranium hexafluoride

Isotopic enrichment

Fuel fabrication

Reprocessing of irradiated fuel

Transportation of radioactive materials and

Management of low-level wastes and high-level wastes related to uranium fuel cycle activities.

Although 10 CFR 51.51 by its language applies to the construction permit stage and not to the operating license stage, Table S-3 is normalized to represent effects from a model 1,000 MWe reactor. Because QCNPS reactors are smaller (912 MWe after uprate), Table S-3 reasonably bounds effects from each QCNPS reactor. It should be noted that because reprocessing has been discontinued, the portion of Table S-3 effects that are attributable to reprocessing represents an overestimate of the effects of the uranium fuel cycle. The radiological effects presented in Table S-3 are small and are not expected to change due to implementation of the proposed uprate. This analysis is consistent with the generic conclusion reached by the NRC in the *Generic Environmental Impact Statement for License Renewal of Nuclear Plants,* specifically Section 6.2 (Ref. 32).

Table 6-1. Table of Uranium Fuel Cycle Environmental Data [Normalized to model light water reactor annual fuel requirement (WASH-1248) or reference reactor year (NUREG-0116)].[a,b]

Environmental Considerations	Total	Maximum effect per annual fuel requirement or reference reactor year of model 1,000 MWe light water reactor (LWR)
NATURAL RESOURCE USE		
Land (acres):		
Temporarily committed[c]	100	
Undisturbed area	79	
Disturbed area	22	Equivalent of 110 MWe coal-fired power plant
Permanently committed	13	
Overburden moved (millions of metric tons)	2.8	Equivalent of 95 MWe coal-fired power plant.
Water (millions of gallons):		
Discharged to air	160	= 2 percent of model 1,000 MWe LWR with cooling tower.
Discharged to water bodies	11,090	
Discharged to ground	127	
Total	11,377	Less than 4 percent of model 1,000 MWe light water reactor with once-through cooling.
Fossil fuel:		
Electrical energy (thousands of MW-hour)	323	Less then 5 percent of model 1,000 MWe light water reactor output.
Equivalent coal (thousands of metric tons)	118	Equivalent to the consumption of a 45 MWe coal-fired power plant.
Natural gas (millions of standard cubic feet)	135	Less than 0.4 percent of model 1,000 MWe output.
Effluents - Chemical (metric tons)		
Gases (including entrainment):[d]		
SO_x	4,400	
NO_x[e]	1,190	Equivalent to emissions from 45 MWe coal-fired plant for a year.
Hydrocarbons	14	
CO	29.6	
Particulates	1,154	
Other gases:		
F	.67	Principally from UF_6 production, enrichment, and reprocessing. Concentration within range of state standards-below level that has effects on human health.
HCL	.014	
Liquids:		
SO^-_4	9.9	From enrichment, fuel fabrication, and reprocessing steps.
NO^-_3	25.8	Components that constitute a potential for adverse environmental effects are present in dilute concentrations and receive additional
Fluoride	12.9	dilution by receiving bodies of water to levels below permissible standards. The constituents that require dilution and the flow of dilution water are: NH_3-600 cfs, NO_3-20 cfs, Fluoride-70 cfs.

Table 6-1. (Continued).

Environmental Considerations	Total	Maximum effect per annual fuel requirement or reference reactor year of model 1,000 MWe light water reactor (LWR)
Ca^{++}	5.4	
Cl^-	8.5	
Na^+	12.1	
NH_3	10.0	
Fe	0.4	
Tailings solutions (thousands of metric tons)	240	From mills only-no significant effluents to environment.
Solids	91,000	Principally from mills-no significant effluents to environment
Effluents – Radiological (curies)		
Gases (including entrainment)		
Rn-222		Presently under reconsideration by the Commission.
Ra-226	.02	
Th-230	.02	
Uranium	.034	
Tritium (thousands)	18.1	
C-14	24	
Kr-85 (thousands)	400	
Ru-106	.14	Principally from fuel reprocessing plants.
I-129	1.3	
I-131	.83	
Tc-99		Presently under consideration by the Commission.
Fission products and transuranics	.203	
Liquids:		
Uranium and daughters	2.1	Principally from milling-included tailings liquor and return to ground-no effluents; therefore, no effect on environment
Ra-226	.0034	From UF6 production.
Th-230	.0015	
Th-134	.01	From fuel fabrication plants-concentration 10 percent of 10 CFR 20 for total processing 26 annual fuel requirements for model light water reactor.
Fission and activation products	5.9×10^{-6}	
Solids (buried on site):		
Other than high level (shallow)	11,300	9,100 Curies comes from low level reactor wastes and 1,500 Curies comes from reactor decontamination and decommissioning-buried at land burial facilities. 600 Curies comes from mills-included in tailings returned to ground. Approximately 60 Curies comes from conversion and spent fuel storage. No significant effluent to the environment.
Transuranic and high level waste (deep)	1.1×10	Buried at Federal Repository.
Effluents-thermal (billions of British thermal units)	4,063	<5 percent of model 1,000 megawatt-electric light water reactor.

Table 6-1. (Continued).

Environmental Considerations	Total	Maximum effect per annual fuel requirement or reference reactor year of model 1,000 MWe light water reactor (LWR)
Transportation (person-rem)		
Exposure of workers and general public	2.5	
Occupational exposure (person-rem)	22.6	From reprocessing and waste management.

a. Source: Table S-3, 10 CFR 51.51.

b. In some cases where no entry appears it is clear from the background documents that the matter was addressed and that in effect, the Table should be read as if a specific zero entry had 7been made. However, there are other areas that are not addressed at all in the Table. This Table does not include health effects from the effluents described in the Table, or estimates of releases of radon-222 from the uranium fuel cycle or estimates of technetium-99 released form waste management or reprocessing activities. These issues may be the subject of litigation in the individual licensing proceedings. Data supporting this table are given in the "Environmental Survey of the Uranium Fuel Cycle," WASH-1248, April 1974; the "Environmental Survey of the Reprocessing and Waste Management Portion of the Light Water Reactor Fuel Cycle," NUREG-0116 (Supp. 1 to WASH-1248); the "Public Comments and Task Force Responses Regarding the Environmental Survey of the Reprocessing and Waste Management Portions of the Light Water Reactor Fuel Cycle," NUREG-0216 (Supp. to WASH-1248); and in the record of the final rulemaking pertaining to Uranium Fuel Cycle impacts for Spent Fuel Reprocessing and Radioactive Waste Management Docket RM-50-3. The contributors from reprocessing, waste management, and transportation of wastes are maximized for either of the two fuel cycles (uranium and no recycle). The contribution from transportation of waste excludes transportation of cold fuel to a reactor and of irradiated fuel and radioactive wastes from a reactor, which are considered in Table S-4 of section 51.52. The contribution from the other steps of the fuel cycle are given in columns A-E of Table S-3A of WASH-1248.

c. The contributions to temporarily committed land from reprocessing are not prorated over 30years since the complete temporary impact accrues regardless of whether the plant services 1 reactor or 57 reactors for 30 years.

d. Estimated effluents based upon combustion of equivalent coal for power generation.

e. 1.2 percent from natural gas use and process.

6.2 COMPLIANCE WITH 10 CFR 51.52, ENVIRONMENTAL EFFECTS OF TRANSPORTATION OF FUEL AND WASTE (NRC TABLE S-4)

NRC regulation 10 CFR 51.52 presents Table S-4 and indicates that, for a reactor that meets specified criteria, Table S-4 summarizes the environmental effects of transporting fuel (both new and spent) and radioactive waste to and from the reactor site on a per-year basis. The table identifies heat and weight per irradiated fuel cask in transit, traffic density, and individual and cumulative dose for workers and the general population under normal conditions. The table also identifies environmental risks from radiological and non-radiological effects under accident conditions. Table S-4 has been reproduced here as Table 6-2.

Table 6-2. Summary Table S-4 - Environmental Impact of Transportation of Fuel and Waste to and from One Light-Water-Cooled Nuclear Power Reactor.[a]

Normal Conditions of Transport

	Environmental impact
Heat (per irradiated fuel cask in transit)	250,000 Btu/hr.
Weight (governed by Federal or state restrictions)	73,000 lbs per truck; 100 tons per cask per rail car
Traffic density:	
Truck	Less than 1 per day
Rail	Less than 3 per month

Exposed population	Estimated number of persons exposed	Range of doses to exposed individuals[b] (per reactor year)	Cumulative does to exposed population (per reactor year)[c]
Transportation workers	200	0.01 to 300 millirem	4 man-rem
General public			
Onlookers	1,100	0.003 to 1.3 millirem	3 man-rem
Along route	600,000	0.0001 to 0.06 millirem	

Accidents in Transport

	Environmental risk
Radiological effects	Small[d]
Common (nonradiological) causes	1 fatal injury in 100 reactor years; 1 nonfatal injury in 10 reactor years; $475 property damage per reactor year

a. Data supporting this table are given in the Commission's "Environmental Survey of Transportation of Radioactive Materials to and from Nuclear Power Plants," WASH-1238, December 1972, and Supp. 1 NUREG-75/038 April 1975. Both documents are available for inspection and copying at the Commission's Public Document Room. 2120 L Street NW, Washington, DC and may be obtained from National Technical Information Service, Springfield, VA 22161. WASH-1238 is available from NTIS at a cost of $5.45 (microfiche, $2.25) and NUREG-75/038 is available at a cost of $3.25 (microfiche, $2.25).

b. The Federal Radiation Council has recommended that the radiation doses from all sources of radiation other than natural background and medical exposures should be limited to 5,000 millirem per year for individuals as a result of occupational exposure and should be limited to 500 millirem per year for individuals in the general population. The dose to individuals due to average natural radiation is about 130 millirem per year.

c. Man-rem is an expression for the summation of whole body doses to individuals in a group. Thus, if each member of a population group of 1,000 people were to receive a dose of 0.001 rem (1 millirem), or if 2 people were to receive a does of 0.5 rem (500 millirem), the total man-rem in each case would be 1 man-rem.

d. Although the environmental risk of radiological effects stemming from transportation accidents is currently incapable of being numerically quantified, the risk remains small regardless of whether it is being applied to a single reactor or a multi-reactor site.

The regulation requires that environmental reports contain either: (a) a statement that the reactor meets specified criteria, in which case its environmental effects would be bound by Table S-4; or (b) further analysis of the environmental effects of transportation of fuel and waste to and from the reactor site. The criteria in Paragraph (a) of 10 CFR 51.52 are not likely to be met by many plants now using higher burnup fuel. The Commission has stated that, in such cases, applicants may incorporate in their analyses the discussion presented in the *Generic Environmental Impact Statement for License Renewal of Nuclear Plants,* specifically Section 6.2.3, "Sensitivity to Recent Changes in Fuel Cycle," and Section 6.3, "Transportation." (Ref. 32).

The NRC published "Extended Burnup Fuel Use in Commercial LWR's; Environmental Assessment and Finding of No Significant Impact" on February 29, 1988 (53 FR 6040). This generic environmental assessment of extended fuel burnup in light water reactors found that "no significant adverse effects will be generated by increasing the present batch-average burnup level of 33 GWD/MTU to 50 GWD/MTU or above as long as the maximum rod average burnup level of any fuel rod is no greater than 60 GWD/MTU." In addition, the environmental impacts of transportation resulting from the use of higher enrichment fuel and extended irradiation were published and discussed in the NRC assessment entitled, "NRC Assessment of the Environmental Effects of Transportation Resulting from Extended Fuel Enrichment and Irradiation," dated July 7, 1988. That assessment was published in connection with an Environmental Assessment related to the Sheron Harris Nuclear Plant, Unit 1, which was published in the Federal Register on August 11, 1988 (53 FR 30355), as corrected on August 24, 1988 (53 FR 32322). In these assessments, collectively, the NRC concluded that the environmental impacts summarized in Table S-3 of 10 CFR 51.51 and in Table S-4 of 10 CFR 51.52 for a burnup level of 33 GWD/MTU and enrichments up to 4 weight percent Uranium-235 are conservative and bound the corresponding impacts for burnup levels up to 60 GWD/MTU and enrichments up to 5 weight percent Uranium-235. These findings are applicable to the proposed action at QCNPS which will limit burnup to 60 GWD/MTU and allow enrichments up to 5 weight percent Uranium-235.

7.0 SUMMARY COMPARISON

This environmental assessment report presents an evaluation of the environmental impacts of the proposed QCNPS EPU from 2,511 MWt to 2,957 MWt. The intent of this report is to provide sufficient information for the NRC staff to evaluate the environmental impacts of the proposed EPU in accordance with the requirements of 10 CFR 51.

Socioeconomic Considerations

The proposed EPU does not significantly affect the size of the QCNPS work force and does not have a material effect on the labor force required for future plant outages. Local taxing authorities will experience an increase in property tax bases and significant positive economic benefits will be realized by local and national businesses participating in this proposed EPU. Finally, the communities in the region of influence surrounding the QCNPS have benefited and would continue to benefit from local taxes paid by ComEd.

7.1 Non-Radiological Environmental Impacts

Terrestrial Resources

Approval of the proposed EPU would result in minor modifications to current land use, due to a small addition to the currently-planned dry cask storage area. The total area affected should be less than one-quarter acre of previously disturbed land that currently provides limited wildlife habitat. However, construction activities could result in the displacement of small numbers of animals (e.g., songbirds and small mammals) that forage, feed, nest, or rest in the area. These construction-related impacts would be small, intermittent, and localized. The additional construction would not impact any historic or archaeological areas. However, there would be some minor changes to visual and aesthetic resources.

Transmission Facilities

No changes in operating transmission voltages, onsite transmission equipment or power line rights-of-way are required to implement or support this EPU. However, there will be a slight increase in onsite power required to support additional EPU equipment. The EMF created by transmission will be increased as an essentially linear function of power. Power production at QCNPS would be less than the capacity at other ComEd stations where no adverse effects from EMFs are known to have occurred.

Noise

No significant increase in noise from the implementation of the EPU at QCNPS is expected.

Waste Management

No new waste streams or significant contributions to existing waste streams are expected from implementation of the EPU at QCNPS.

Air Effects

No equipment additions or changes in operation will occur with EPU to increase air emissions.

Hydrology Effects

A number of configuration changes have been made to the systems used to control the discharge of cooling water at QCNPS. Design configurations have chronologically included open-cycle discharging of heated effluent along a straight wing dam; an open-cycle, two diffuser pipe system; a closed-cycle, spray canal system with blow-down directed into a third diffuser pipe in the river; partial open-cycle operation of the condenser cooling system; and finally, a return to the open cycle, two-diffuser pipe system.

A temperature monitoring curve is used to demonstrate compliance using river flows when river flows are greater than 16,000 cfs; plant load management or physical measurement of river temperature when river flows are from 11,000 cfs to 16,000 cfs; and physical measurement of river temperature when river flows are less than 11,000 cfs. The EPU will not change the hydrodynamics of the condenser cooling system. The temperature monitoring curve will be adjusted to reflect higher river flow conditions where physical measurement or load management must occur.

The EPU will not affect groundwater use.

Surface water withdrawal will not be affected by the EPU. The maximum flow of river water through the station will not change.

Aquatic Resources Effects

Higher temperatures associated with EPU are expected to affect certain organisms entrained in the system (i.e., ichthyoplankton). Entrained ichthyoplankton will likely be destroyed, with the possible exception of fish that spawn early in the year. The loss of entrained plankton is not significant for the local populations involved because entrainment captures only 0.5 to 1.0 percent of the drift by the station.

Ichthyoplankton may come into contact with higher temperatures in the mixing zone under EPU conditions. Because ichthyoplankton are more vulnerable to upper lethal temperatures than to any particular temperature increase, only late-spawning species are expected to be materially affected. Ichthyoplankton losses are not expected to impact reproductive fish populations. Adult and juvenile fish are expected to avoid the increased temperatures in the mixing zone and thereby not be harmed. Some mussel species in the mixing zone may be exposed to higher temperatures that could alter the timing of their life cycles.

No impacts to Federal or State threatened or endangered species are expected from the higher temperatures associated with the uprate.

Implementation of the EPU will not require any changes in the intake structure or intake flows at QCNPS; therefore, entrainment impacts to fish and shellfish in the early life stages due to the EPU are expected to be insignificant.

Incidents of cold shock should not increase as a result of EPU due to the anticipated gradual reduction in discharge temperature and the rapid mixing and heat dissipation in the mixing zone. Gas bubble disease should not increase because effluent flows will remain the same.

7.2 Radiological Environmental Impacts

Radioactive Waste Streams

A small addition to the currently-planned dry cask storage area is projected for the proposed EPU. At EPU conditions, the solid radioactive waste burial volume is expected to increase approximately 10 percent, the liquid radioactive release volume is not expected to increase and the gaseous radioactive release volume may increase up to 18 percent. The proposed EPU will not introduce any new or different radiological release pathways.

Radiation Levels and Offsite Dose

Offsite dose from liquid and gaseous effluents may increase up to 18 percent. Calculated offsite dose from sky shine will increase proportional to EPU. However, actual offsite dose from sky shine is not expected to increase significantly. At EPU conditions, actual offsite dose will remain significantly less than applicable standards.

Occupational Radiation Exposure

Radiation levels and associated doses are controlled by the ALARA program, which includes facility shielding designs. Normal operation radiation levels increase slightly. The minor increase in radiation levels will not affect radiation zoning or shielding. Therefore, no new dose reduction programs are scheduled and the ALARA program will continue in its current form.

7.3 Environmental Impacts of Accidents

The accidents presented in FES bound the realistic consequences of accidents that could occur with implementation of the EPU.

7.4 Alternatives to the Proposed Action

Two, approximately 206 MWe alternatives to the QCNPS EPU were evaluated. In addition, the "no-action" alternative is available whereby the station continues to operate under current power levels, environmental impacts remain unchanged, and ComEd develops an alternate energy strategy.

Based on 1998 generation data for the State of Illinois, coal (53.6 percent), nuclear (42.4 percent), gas (3.4 percent), and petroleum (0.6 percent) provided the primary energy sources for generation of electricity. Therefore, based on these and other internal evaluations, ComEd concluded that, for incremental increases in generation capacity, only pulverized coal- and gas-fired units would be analyzed to meet these needs.

Coal-Fired Generation

ComEd concluded that a coal-fired plant, located at QCNPS, would have moderate impacts on air quality, with the impacts being clearly noticeable. ComEd also believes that, with proper siting and waste management and monitoring practices, waste disposal would also create a moderate, noticeable impact. This is based on the assumption that adequate space can be located within the QCNPS footprint for the disposal of waste material. However, permitting and approval for such an operation may be difficult given construction requirements for siting and installing disposal facilities.

Impacts to other resources would consist of impacts to land use, primarily for the storage of coal and ash. Impacts would be mostly visual with some habitat loss. Visual impacts would be consistent with the industrial nature of the area. Socioeconomic impacts would be minimal, due to the proximity to large metropolitan areas. Utilization of the current cooling water system would minimize impacts to aquatic resources and water quality.

Compared to the implementation of the EPU at QCNPS, the implementation of the coal-fired alternative for the same amount of electrical power would result in significant environmental impacts to air quality and land use/waste management. In addition to the environmental impacts, implementation of a coal-fired power plant would require a significant amount of additional approvals through the regulatory permitting process as well as obtaining acceptance and approval from the public. QCNPS currently has a good relationship with the local and regulatory communities who understand the function of QCNPS. Any change in Station operations that would use both nuclear and coal-fired power plants for generation of electricity could prove difficult. Therefore, implementation of the EPU would result in fewer environmental, community, and regulatory impacts.

Gas-Fired Generation

The gas-fired alternative would also be situated at the existing QCNPS site on previously disturbed land, thus reducing construction impacts. The alternative would use the existing cooling water system, thereby reducing aquatic impacts from operations. Land use would be less than for the coal-fired alternative, due to the smaller footprint.

Impacts on air quality would be moderate, but smaller than those for coal-fired generation.

Implementation of the gas-fired alternative would result in almost no waste generation and would produce minor impacts on the surrounding environment. Therefore, ComEd concluded that waste management impacts would be small.

The most significant impact would involve the construction and operation of a new gas pipeline. The pipeline would consist of approximately five miles of 16-inch buried pipe. Primary impacts would be associated with construction activities during the installation of the pipeline. These activities could result in loss of habitat for some terrestrial species as well as impacts due to soil erosion. Best management practices would mitigate soil erosion impacts. Additional land use requirements on-site would be significantly less than the coal-fired alternative thus reducing land-dependent ecological, aesthetic, and cultural resource impacts. Operational impacts would not be severe once initial construction was completed. Consumptive water use would be about the same, thus minimizing impacts to aquatic resources and water quality. Socioeconomic impacts would be significantly less than the coal-fired alternative due to short construction period and small work force.

Compared to the implementation of the EPU at QCNPS, the implementation of the gas-fired alternative for the same amount of electrical power would result in additional environmental impacts, primarily associated with air quality and the construction of the pipeline. As with the coal-fired alternative, additional regulatory approvals would be required as well as the need to obtain public acceptance and approval. QCNPS currently has a good relationship with the local community and a change to dual generation by both nuclear and gas-turbines could be difficult. Therefore, implementation of the EPU would have less of an impact on the environment and the regulatory approval process would be streamlined.

7.5 Conclusion

This environmental report demonstrates that, in most cases, implementation of the proposed EPU at the QCNPS does not involve any new environmental impacts that are significantly different from those presented in the FES or in subsequent referenced documents for the current operating power level. Where environmental impacts differ from those previously presented, these impacts have been shown to be insignificant and well within regulatory and/or permit limits. Outlined below are key conclusions of this environmental assessment report:

Socioeconomic

- The QSNPS work force would not be affected. Salary compensation and material costs associated with EPU implementation would result in a positive influence on the economy of the region.

Implementation will make ComEd more competitive in the deregulated market.

Non-Radiological

- Up to one-quarter acre of previously disturbed land would be required for additional dry cask storage. Impacts would be small, intermittent, and localized and would not impact any historic or archaeological resource.
- No changes in transmission voltages or associated facilities; all transmission lines meet or exceed NESC requirements.
- No significant increase in noise and no new waste streams expected nor will there be any increases in air emissions.
- Thermal compliance of the cooling water system will be achieved by implementation of a new temperature monitoring curve as a stipulation of the Station's NPDES permit.
- No impacts to groundwater use.
- No changes in maximum surface water withdrawal or flow through the Station.
- Increased thermal loading could impact ichthyoplankton however, projected losses would not be significant. No impacts to the Federally endangered mussel *Lampsilis higginsi* or any other Federal listed threatened or endangered species. Potential for minor impacts to late-spawning fish species, but effects on aquatic community are expected to be insignificant.
- No changes in intake structure design or flow and no changes in entrainment or impingement rates for aquatic organisms.

Radiological

- Additional space to accommodate dry storage of an additional three to four casks every five years is anticipated.
- Solid radioactive waste burial volume will increase by about 10 percent, the radioactivity of liquid effluent releases will increase up to 18 percent but the liquid radioactive release volume is not expected to increase. Gaseous releases are estimated to increase up to 18 percent.
- Liquid and gaseous effluents will remain within regulatory standards.
- Offsite radioactive dose will remain significantly less than applicable standards.

- Minor increase in occupational radiation exposure however, no new dose reduction programs are needed and the ALARA program will not change.

Accidents

- Estimated dose as a result of an accident are within the limits presented in the FES and therefore, the realistic consequences are acceptable.

Alternatives

- The coal-fired power plant alternative would have significantly greater impacts on air quality, waste generation, and land use than implementation of the EPU. Emissions of sulfur oxides, nitrogen oxides, carbon monoxide, and particulate matter would all be emitted in excess of major source thresholds and may require emission offsets, credits, or other control techniques. Waste generation would be significant, requiring significant land for disposal of ash and scrubber waste even with an effective recycling program for the waste. Additional land use impacts would be associated with construction of the power block and coal storage area. No changes would be needed for cooling water system and associated impacts would be similar to current use. Visual impacts would result from the additional stacks, boilers, and extensive rail deliveries of coal, but would be consistent with the industrial area. Permitting and approval would be difficult and public acceptance and approval would likewise be difficult.

- The gas-fired alternative would also have significantly greater impacts on air quality and land use compared to the proposed EPU. Air emissions would be less than those of the coal-fired alternative, but would still result in significant emissions of sulfur oxide, nitrogen oxide, carbon monoxide, and particulate matter above source thresholds and would require emission offsets, credits, or other control techniques. Waste management impacts would be insignificant. However, significant impacts and cost (estimated $5M) would be associated with the construction of approximately five miles of gas pipeline. Pipeline construction would result in loss of some wildlife habitat and soil and erosion impacts could occur; however, best management practices would be implemented to minimize impacts. Pipeline construction could also impact cultural resources however, necessary preservation measures would be undertaken to minimize impacts. Permitting and approval would be difficult and public acceptance and approval would likewise be difficult

Based on the analysis presented in this environmental report, the implementation of the EPU at QCNPS is the preferred alternative.

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